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Construction Kits

for Ship Models and Furniture





KIT F-Materials for 12-in, model of Manhattan





The historic Hartford-KIT L





EVERY hand you hear hobbies being talked about as never before. There are, of course, hobbies of many kinds, but none is more genuinely satisfying or has more real and lasting value than that

of making things with your hands.
"But how am I going to get started?"
you may ask. "I have never made anything
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KIT E

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A. Whaling Ship model Wanderer. All

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кіт Ј Materials for a minfature clipper ship





KIT A

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materials (except paints) for a model 25 in. long, and Blueprints Nos. 206 to 200. 6.75 GG. Same with hull blocks shaped, 7.25 H. Cruiser U.S. S. Indianapolis, Ali raw. 12-15 model, and Blueprint No. 216. 1.50 J. Clipper ship Sea Witch. All raw materials (except paints) for a simplified 13-in. model, with blueprint 1.50 L. Farragut's flagship Hartford, a steam-and-sail eloop-6-war. All raw materials

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State (Please print name very clearly.)

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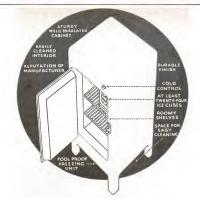
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REO MOTOR CAR CO. LANSING, MICH.



• BUYING AN Electric Refrigerator

THINGS YOU SHOULD KNOW BEFORE INVESTING YOUR MONEY IN AN AUTOMATIC COOLING PLANT ARE CLEARLY SET FORTH IN THIS ARTICLE

By R. M. Bolen
Secretary, Popular Science Institute

VERY month, Popular Science Institute receives letters from readers asking whether a certain make of automatic refrigerator offers the best value for the money. Many readers cannot decide between two or three well-known makes, Others mention refrigerators whose names are entirely unfamiliar.

To assist these readers, as well as other prospective refrigerator buyers, the Institute has attempted to formulate a number of rules that should simplify the problem and make it an easy matter for any mechanically minded person to make a satisfactory choice.

In the first place, the buyer should acquath thinself with the various types of automatic refrigerators on the market. Roughly, they fall into three classes: the electric type, the gas type, and a comparatively new unit operating on oil. In operation, the general principle governing all three is more or less the same.

Almost everyone at some time or other has let the air out of an automobile tire and noticed the relatively cold air that escapes. In the same way, everyone who has ever had the misfortune to pump up a tire knows that the base of the pump becomes warm. Compression heats a gas and expansion cools it, and it is this swapping back and forth of heat by a gas as it is compressed and expands that serves as the principle of all mechanical refrigerators.

In an electric refrigerator, the refrigerant gas is compressed by a mechanical compressor. In a gas or oil-fired unit, a tiny flame takes the place of the mechanical compressor. The refrigerant gas is dissolved in water. When the liquid is heated the gas is freed so rapidly that in filling the space at the top of the container it becomes compressed.

After compression, whether by mechanical or other means, the refrigerant gas then is allowed to expand quickly and like the escaping air from an automobile tire, it becomes instantly cold.

Obviously, a good automatic refrigerator must have a foolproof freezing unit. To be economical as well as safe, it must be dependable and good for long periods of operation without servicing.

The second requirement of a good re-

frigerator is a sturdy, heat insulating cabinet. Without it, even the best freezing unit will be costly to run. Heat that steals in through the walls or door, offers just that much more resistance to the chilling effect of the cooling coils,

To be convenient as well as efficient, the cabinet must, of course, have incor-porated in it certain features. First of all, it should be easy to clean. Its inner surface should be of some material that does not spot easily and the shelves should offer the least possible surface to particles of

food that may be spilled. Besides adequate provision for the making of ice cubes, the automatic refrigerator's equipment should include a vegetable tray and well-planned shelf space. Shelves that are too close together offer a problem when storing tall bottles or large dishes and shelves that are too wide apart mean wasted space and in-

creased operating cost. Even the method of mounting should be considered when buying an automatic refrigerator. Cabinets placed close to the floor offer a problem when it comes to cleaning under them. It should be possible to pass a broom under the cabinet without too much stooping.

To be most efficient during all the seasons of the year, an automatic refrigerator also should offer some means of cold control so that the rate of freezing can be altered to suit the demands of the weather and the requirements inside the cabinet.

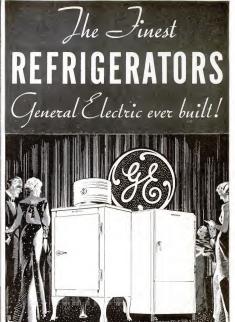
Although the householder can judge the appearance of a refrigerator and its many features, he has no visible way to assure himself of the dependability and efficiency of the unit as a whole. He has, however, one signpost to guide him-the reputation of the manufacturer. The seal of a reputable manufacturer on the cabinet of an automatic refrigerator is proof that the unit has been tested and retested by housewives as well as engineers in an effort to make it convenient and dependable.

Home Workshop Lighting Booklet Now Ready

¬O HELP readers improve the lighting in their home workshops, Pop-ULAR SCIENCE MONTHLY has prepared an up-to-the-minute booklet on shop illumination. It will answer your questions about lamps, circuits, and workshop planning and help you to place switches and outlets conveniently. No shop owner should be without one.

To obtain this new booklet, use the coupon below.

381	lar Science Institute. Fourth Ave., York, N. Y.
I wa worksh coin).	nt your new booklet on lighting the home op. Enclosed is ten cents in stamps (or Send it to
Name	***************************************



ONG recognized the leaders in performance, G-E refrigerators now capture the admiration of every housewife who appreciates smart styling and modern design. Brilliantly beautiful in their faultless simplicity of line, these new G-E models are the aristocrats of refrigerators... both in appearance and mechanism.

Be sure you see the new 1934 G-E de luxe models before you select a refrigerator for your kitchen. Note the new refinements, new improvements, and the many features only a G-E gives you.

Look at both types: (1) The Monitor Top and its famous sealed-in-steel, attention-free mechanism. It has an unparalleled record for dependable, trouble-free performance at low cost. And, (2) the G-E flat-top with its smart styling, convenience features and performance capacity found in no other popular priced refrigerator.

For your nearest dealer see "Refrigeration Electric" in classified pages of your telephone book. General Electric Specialty Appliance Sales Depart-ment, Section M-5, Nela Park, Cleveland, Ohio.

- Quiet in operation can scarcely hear it.
- Uses less current. Full re-frigerating capacity for even unusual demands.
- Sturdy All-Steel cabinets with glistening whiteenamel exterior, or gleaming porce-lain both inside and out.
- Sliding shelves, adjustable in height.
- Stainless steel freezing chamber, cannot chip or rust, freezes more ice faster.
- Convenient temperature control forfast orslow freez-ing, refrigeration uninter-rupted when defrosting. Automatic interior lighting.
- · Auxiliary foot-pedal door
- New modern nardware.
 De luxe Monitor Top models completely equip-ped with covered glass food containers, chiller tray, vegetable pan, etc.



Our Readers When Those Happy Days Arrive

Will the Road Hog Be Alive?

IF ALL develops as anticipated, every driver will respect traffic laws and signals which will not be nerve-racking bells, confusing, blink-

ing lights, whistles, or hard-boiled cons. but silent electrical waves or beams that will govern the speed of cars in the various zones and stop them at intersections without vigilance on the part of the drivers. Cities will install simple equipment that will charge the vari-ous zones with electrical waves that will



regulate the speed of cars and stop them at the intersections as required by law. Until such time as all cars are equipped in the factory with the necessary devices, a simple device may be installed in each car that will permit these electrical waves to operate small lights in each car directly before the driver climinating any excuse for failure to obey regulations. Would it not be bliss to eliminate the annoying bells of stop signals, the worry of watching for lights, the dodging of cars whose drivers do not respect laws or signals? By this electrical system all drivers will automatically be forced to drive sanely. -T. R. S., Van Nuvs, Calif.

Read Popular Science and Fixed His Own Camera

I WOULD like you to know that the articles appearing in POPULAR SCIENCE MONTH-Ly are not published in vain. To mention one instance: In the early part of September my camera fell to the ground, with the result that the focusing scale was thrown out of register. I had about decided to send it to New York for adjusting when an article in your magazine answered the question and I fixed it myself. Tilting tops as you know are expensive; so I am hoping that in some future article you will show how one may be made.—H. S. B., Springfield, Mass.

Reader in British India Asks for Book Reviews

In referring to several back numbers of POPULAR SCIENCE MONTHLY, I find that rarely do you give a report on the publica-

tion of any standard scientific book on any Will you very kindly articular subject. have a department devoted to book reviews in your valu-able journal? A list of standard and up-todate books on the subject discussed in each article printed in POPULAR SCIENCE MONTHLY, also would



be a help to those who would like to pursue the subject fur-ther.—B. B. J., Post Chharodi, British India.

Adding-Machine Enthusiast Curious About Its Insides

This morning, while I was pressing the small keys of an adding machine, and adding up millions of dollars a minute, the thought struck me that, like the telephone and radio and other modern phenomena this generation is so accustomed to, this machine is a marvelous achievement. Why not an article on the mechanism and working of the adding machine, the comptometer, or even an accounting machine? It is surely science, and, I presume, would be of interest to many readers. I have heard that the adding machine runs on the same principle as the speedometer, but I wager few know how the speedometer in their cars work.—G. D. N., Windsor, Conn.

Microscope and Camera Take Picture of Goldfish's Tail

HERE is the description of an experiment performed by the "Experimental Biology Club" of De Witt Clinton High School, of New York City. We used an eight mm. movie camera loaded with panchromatic film. The microscope was a binocular which is the best type to use as you can watch the field while ou are photographing. The camera lowered onto one of the oculars, care being taken to see that it was in a straight line with the barrel. Next, a piece of black cloth was wrapped around the point where the camera lens and the ocular

met to prevent any possible light leakage. Then the subject, a goldfish, was placed under the microscope, its head and gills wrapped in watersoaked cotton. The goldfish was moved so that the thin part of its tail was under the lens. Since the lens



DEADY-LIGHTS

necessary to open the lens to its largest aper-ture, F:3.5. Now a beam of sunlight was allowed to fall on the mirror of the microscope and reflected through the stage. Then we focused the microscope by looking through the other ocular. Then we "shot."—H. S., New York, N. Y.

Dust in Air Causes Those Bewildering Moving Shadows

IN A recent issue of POPULAR SCIENCE MONTHLY I read the article from E. W. J., Van Buren, Mo. It seems to me that the only logical answer to his problem would be the dust in the air. We all know that air is made up of a combination of gases and that these gases are invisible. We also know that heat causes convectional currents in this air. Now there is always a certain percentage of dust suspended in the atmosphere and that percentage is relatively higher in a house than outside. Then as the hot air over the radiator rises, the dust suspended in the air also rises and in getting between the sun and the floor it casts those moving shadows since the dust itself is moving. A blast of cold air will stop the motion for a minute since the cold air will stop the current of rising air .- I. W. R., Plattsburgh, N. Y.

Natives of Australia Still Throw Spears with Womerah

IN AN interesting article by Robert E. Martin, in a recent issue of Popular Science MONTHLY, a native is shown in the act of throwing a spear, and as far as I can under-

stand he is propelling the weapon by means of a short handled throwing stick. In the North ern part of Central Australia, where the blacks are still uncivilized, they use the weapons of their forefathers, and among them is what is called a "Womer-ah." This is a han-This is a han-



dle into which the handle of the spear fits loosely. With the Womerah, the black man can propel his spear very accurately and for a relatively great distance. The picture in your magazine is posed in exactly the self-same manner as the Australian poses when using his weapon. Yours is the best magazine I have read in many a long day.—J. S., Plumpton, N. S. W., Australia.

He Answers One Question And Then Asks Another

IN ANSWER to the question of A. H. W. concerning the letting in of ultra-violet rays by a rocket plane, the ozone, unquestionably, flows back over the rupture. Now the ques-tion that I would like to ask is how to protect the passengers of a space ship from the ravages of these same short ultra-violet rays?-S. V. F., East Cleveland, Ohio.

His Theory Says Light from Moving Object Comes in Curve

WHEN reading Our Readers Say in a recent issue of POPULAR SCIENCE MONTHLY, I came across something on light which reminded me

of a pet theory of mine. Here it is: Light from a mov-ing object, like a star, does not travel in a straight line. As the star moves, it sends out light, so that the position of the source of the light may vary by several million miles. Directly comparable to this, I think, is a



hose with water coming out of it. If the hose is moved around, the water comes out in an



LIFT the lid of this box and you open a private tonsorial parlor. All the professional deftness and skill of the expert barber are shaped in Gem's modern design.

The straight, slant-top frame presses the slack out of flesh folds-tightens the skin like a barber's stretching fingers, and brings all bristles against the blade at right angles and root level.

Gem moves with the barber's swift, tugless, face-length glide. It gets all the stubble with a

once-over that leaves the wiriest chin trig and trim for twentyfour hours.

Only Gem can give such a shave, because Gem controls the patents on Dual Alignment, which makes it absolutely safe to use the sharpest blades on earth. Thick beards that take the heart out of fragile, shallow edges can't hold out against the 50% thicker surgical steel, which Gem strops 4840 times to produce a scuffless, ouch-proof blade.

We give Gems a deep, tapered wedge-edge that Dual Alignment locks unbudgingly at five points. Gem Micromatic Blades last so much longer that substitutes are a penny-pinching extravagance. Gem Razors last forever.

Made in one piece with no take-down parts. Gold-plated sets-\$1 anywhere.

Or a trial kit with Gem's latest razor and two blades, for your quarter and our coupon.

GEM Razor and Blades ADDRESS

arc. I think the same thing would be true of light. On the earth, however, the theory do vou readers think?—A. H., Glen Ellyn, Ill.

Homemade X-Ray Machine Is His Modest Desire

I WOULDN'T trade my copies of POPULAR Science Monthly for any other periodical on science. I have them all bound in your

special covers, and I think it's the best reference library there is. For every volume that holds twelve issues I have compiled my own complete index, which I pasted on the inside of the cover. Please publish an article on how to construct a simple Xray machine without



having to purchase any expensive equipment. I also think you should have more articles on how to build Oudin, Tesla, and other kinds of experimental induction-coil apparatus with an explanation of their phenomena.—M. P., Brooklyn, N. Y.

In This Strange Land Moon And Rainhow Shine at Night

In a recent issue of your magazine under the caption "Why a Rain Bow? Isn't a nice Moon enough?" L. M. G. of Lewiston, Pa., wants to know if any one has ever seen a rainbow at night? If L. M. G. will make a trip to El Volcan in the Republic of Panama, three hundred and fifty miles from the City of Panama, during the months of January, February, March or April and there await moonlight nights he can see real rainbows at night and full moons too .- T. C. J., Balboa, Canal Zone

One More Free-Will Editor Tells What He'd Like

It seems as if every one of your readers has some suggestion or other to make toward making Popular Science Monthly suit them better. So, falling in line with the rest, I present my idea of a better magazine, (if possible). From time to time I have noticed letters from your readers asking for articles on dirt-track racers. It is my idea that such articles would be appreciated by many. Let's have more like Martin Bunn's articles. Now that almost everyone has his own car I am sure they would like to know more about them. Discuss more fully the new improvements, like individual wheel suspension, automatic clutch, twin ignition, etc. Give us articles on converting older cars into dirt-track racers.—T. B., Louisville, Ky.

He's Lost in an Atom and Too Worried to Sleep

I'M IN plenty of trouble and in serious need of help. The thing that gets me is this: Is our universe a giant atom? You have often seen pictures of atoms

showing their structure,and you have also seen pictures of our universe showing how it is made up of suns and planets. Have you ever stopped to compare these two pic-tures? Well, I did, a long time ago. And I have not had a good night's sleep since. hope some reader can



solve this problem and relieve my anxiety so I can sleep.—H. M. McN., London, Ont.

Diameter of Chinese City Is Found to Be Nine Miles

I am writing you regarding the problem presented by C. D., Courtenay, Can., in Our Readers Say department in a recent issue of the Popular Science Monthly. I solved the problem by two different methods obtaining the answer of nine miles for the diameter of the city by both the geometric and the trig-onometric methods.—K. B., Saginaw, Mich.

Amateur Chemists Voice Approval of Our Articles

I AND other amateur chemists appreciate the article in the issue of March, 1934, of POPULAR SCIENCE MONTHLY on Home Laboratory Tests, so please keep up the good work. We would also appreciate articles on blow pipe analysis or on static electricity. I agree with J. F. W. who wants articles on highfrequency apparatus, induction coils and staticelectric machines.—A. B., Corning, N. V.

Suggests Use of Compressed Air To Keep Waves Away from Ship

IN A recent issue of POPULAR SCIENCE MONTHLY, I read in Our Readers Say a description of a gunboat that was once pro-pelled by water forced from the stern. This reminded me that I read, some years ago, of the use of compressed air to break up storm

waves and effectively protect the coast. think the experiment was tried at Galves-ton, Texas. Now all of this makes me wonder if compressed air could not be projected before the bow of a boat to help it when breasting heavy seas. I suggest that a pointed projection beneath the waterline, with the air



passing out at the top, would be most ef-fective.—G. H. I., Scarboro, Ont.

Modern Tinkering at Hobby Put into Modern Verse

E A hobby man, That's the kind of a guy I am, An individual thinker Therefore, like to tinker.

Finding outlet for creative urge, Makes the blood through my veins surge; Sometimes it's the artists' lure— Although pictures are a blur.

Then again, music, composition, Journalism beckons; But oh! Materialism reckons: Come down to earth from spiritism.

Your body also needs attention, So the basement we now mention, For there, thanks to a hobby mere, We have on the cement floor painted A shuffle board, all colors tainted

On which to vie our skill and boredom kill

And so to the wide, wide world I say,
"The happiness a hobby brings, the tinkering family sings."—L. V. G., Chicago, Ill.

Evolution and Surgery Were His Pet Articles

Your magazine is one which is read from cover to cover at our house and I receive many suggestions that work to make and save money in our factory. The outstanding arti-cles which I enjoyed in the past have been the series on the evolution of man and the ones about the practice and development of surgery written by Dr. Damrau.—S. M. J., Middlefield, Ohio.

A Musterious Thing is a Ring on a String

IN AN old book, published in 1892 by W. P. Bullard & Co., Boston, Mass., the following item appears under the mysterious title, "Fireside Mesmerism." "Take a gold ring. "Take a gold ring, the larger the better. Attach the ring to a

silk thread about twelve inches long. Fasten the other end of the thread around the nail joint of your right fore-finger and let the ring hang about onehalf inch above the surface of the table. upon which you rest your elbow to steady your hand. Hold your



right fore-finger horizontally, with the thumb thrown back as far as possible from the rest of the hand. If there be nothing on the table, the ring will soon become stationary. Place some silver, say three half-dollars, immediately below the ring. The gold ring will begin to move, backwards and forwards, to you and from you, Now bring your thumb in contact with your fore-finger and the movements of the ring will become transverse to their former swing. Or, the same transverse movement may be effected by having a lady take hold of your disengaged hand. When the transverse motion is fairly well established, let a gentleman take hold of the lady's disengaged hand and the ring will change back to its original course." I tried this before a group of people with success but, so far, have been unable to locate anyone who can explain it. I will greatly appreciate an explanation by one of your readers. I will also appreciate having information on what difference it makes whether a lady or gentleman takes the hand of the experimenter .- G. P. K., Cleveland Heights, Ohio.

Space Born as Exploding Atom Created the Universe

IN REPLY to R. D., Jr., I should like to say, that according to the famous Abbe Georges LeMaitre's theory, the entire universe was formed as a result of the blast of a giant atom, and before this atom exploded, space had not come into existence. Formerly there were theories that stated the planet Mars was inhabited, but recent investigations show there is no life on that planet or on any other planet in the solar system. There may be, however, life elsewhere in the universe .-B., Folcroft, Pa.

If You Bury the Knockers, You Take the Joy out of Life!

IT WOULD be a fine idea if all the fault finders that complain about articles in Popuend six feet under ground in the Sahara Desert. I read all your pieces with interest,

and can hardly wait for the first of the month to come. I take two other scientific magazines, but find that POPULAR SCIENCE is the best of all. I am very much interested in radio, and would be grateful if you would publish an article on how



to build a midget all-electric set, using four or five tubes .- S. B. S., Watertown, Conn.

BABY JIM'S ALL PAID FOR NOW

YOUNG JIMMY BROUGHT US LUCK.RUTH, I GOT THAT JOB TODAY.



IATER

WISH I COULD PAY THE WHOLE BILL, DOCTOR, BUT I DON'T KNOW HOW LONG MY JOB WILL LAST



YES, I WAS TAKEN ON BY A FINE FIRM, EVERY THING ROSY UNTIL LATELY. NOW THE BOSS ACTS COOL-PUTS OTHER MEN AHEAD OF ME. ID QUIT ONLY ...

SUPPOSE YOU LET ME SUGGEST SOMETHING FIRST... BUT HOW COULD LHAVE "B.O." AND NOT KNOW IT DOCTOR ?

> WE GROW ACCUSTOMED TO AN EVER-PRESENT ODOR THE THING TO DO IS TO PLAY SAFE



"LL NEVER RISK LIFEBUOY LATHER IS GREAT, SO CREAMY, CLEAN-SMELLING



"R.O." GONE _

lasting prosperity for this family

JIMMYS ALL PAID FOR RUTH! GOT MY RAISE TODAY - 50 I SETTLED WITH THE DOCTOR





RUTH, I'VE NEVER SEEN YOUR COMPLEXION SO FRESH AND CLEAR! WHAT'S YOUR SECRET

> LIFEBUOY, DEAR . IT'S WONDERFUL FOR THE SKIN



K EEP your complexion young—softly sparkling, crystal clear.
Difficult? Expensive? Not with this simple, refreshing 'home" facial! Work up a rich Lifebuoy lather. Massage it well into pores; then rinse. Do this nightly—see skin bloom with health. Your turn now to enjoy a radiant, Lifebuoy complexion!

Facts about "B. O."

We all perspire a quart a day. We grow accustomed to the odoroffend unknowingly! Play safe -bathe regularly with Lifebuoy. Its purifying lather deodorizes pores—stops "B.O." (body odor). Its fresh, clean, quickly-vanishing scent tells you Lifebuoy protects! A PRODUCT OF LEVER BROTHERS CO.



ARE HERE AGAIN! SNAPPY SHAVES











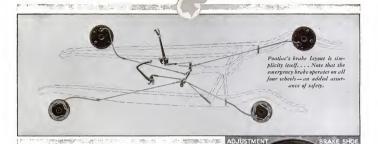
WHAT A SHAVE ... WHAT A SHAVE I CLEAN .. SMOOT NO PULL...NO SCRAF ...NO BURN, FROM OW ON IT'S LIFEBUOY FOR ME!



Send for a FREE Trial Tube

Try Lifebuoy Shaving Cream. Get the big red tube at your druggist's. Or write Lever Bros. Co., Dept. A145, Cambridge, Mass., for a free 12-day tube. (This offer is good in U. S. and Canada only.)





Pontiac Brakes are Simple, Positive

...SAFE!

NEW BRAKING SYSTEM
CONSIDERED THE FINEST
IN THE AUTOMOBILE
INDUSTRY

NO MOTOR car is safer than its brakes—and so Pontiac has adopted for 1934 a system that is recognized by automotive engineers as the simplest and most dependable in the entire automobile industry.

Pontiae's Bendix mechanical brakes provide the sures and safest method of controlling deceleration in use today. Their action is fully equalized—not by socalled "equalizers" located at some point in the linkage, but at the point of final action, within the drums themselves. Due to Servo action, slight pressure at the brake pedal is multiplied many times at the wheels. Thus, the car stops quickly, smoothly and evenly at a light touch of the driver's foot.

Pontiac's Bendix brake "hook-up" is the least complicated of any system in the industry. It consists, in its essentials, of brake assemblies, operating cables, rocker shaft, rod to brake pedal and the pedal itself. Due to extreme simplicity, there is practically mothing to get out of order. But if a mishap thould occur to one cable, the entire system would not be put out of commission—there would still be three effective brakes. As a matter of fact, you could saw the rocket shaft completely in two and still have braking power on all four wheels, if both foot pedal and emergency pedal were used.

Owners of the 1934 Pontiac thus have the assurance that the smooth, quick, safe action of their brakes complements the new power and speed of the famous Pontiac Straight Eight engine. Pontiac Motor Company, Pontiac, Michigan.

OPERATING-CAM

Pontiac brake drums are 12 inches in diameter and linings are 1¾ inches wide. The two shoesfill almost the entire circumference of the drums. This gives Pontiac 182 square inches of braking surface.

Running around the outer rims of the high (,75) carbon manganese steel drums are ribs which strengthen the drums and pass off beat when brakes are applied. Note, also, the seal against water at the inside edge of the drums.



Pontiac's brake cables are pre-stretched and of one piece. Each will stand a strain of over 3000 pounds. In fact, a Pontiac Coupe could be safely lifted by a single cable. From frame to wheels, cables are enclosed in a flexible conduit packed with grease.

Get a Straight Eight for your money!



POPULAR SCIENCE

May 1934

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RAYMOND J. BROWN, Editor

HOW UNCLE SAM'S

Scientific Detectives

SMASH Cidnap Gangs



AKE kidnaping such a dangerous, hazardous racket nobody will That was the assignment handed

some twenty months ago to the Department of Justice. It set in motion the greatest crime offensive

of a generation.

A wave of kidnapings was sweeping the country when, in the spring of 1932, the so-called Lindbergh Law loosed the Federal detectives. What followed comprises one of the most thrilling chapters in the history of police work.

John Edgar Hoover.

Department of Jus-tice chief and nem-Of twenty-four kidnaping cases recorded since June. 1932, only one remains unsolved! Fifty-three esis of kidnapers

snatchers have been convicted. Eleven are behind the bars for life. Two have been condemned to death. Three have committed suicide. In a majority of cases, the crimes were solved in thirty days and in many instances the kidnapers were on their way to the penitentiary in less than two months. In this spectacular manner, the government has cracked down on the kidnap racket.

Behind this dramatic activity, with its rapid-fire con-victions, is the dynamic personality of the head of the Division of Investigation of the U. S. Department of

Justice, John Edgar Hoover.

One recent morning I sat for nearly two hours in his office in Washington, while he told me how kidnap gangs are run to earth. Later, I went through record files, followed the investigations in a score of cases and watched men at work in the scientific crime detection laboratory which has played a part of ever-increasing importance in the investigations.

While I talked with Hoover, reports were flashing in from twenty-five key cities in the country. They carried isolated bits of information, tips. rumors. They appeared of little consequence, individually. But to the high command of this crack army of law enforcement,

they were like the pieces of a jig saw puzzle. They fitted





By EDWIN TEALE

Picture Story of the Solution of a Famous Kidnap







The armed kidnapers seize their victim as he is playing bridge with friends at his home

The kidnaped man's family starts the man hunt by phoning the Department of Justice

A friend of the victim delivers the ransom money and the kidnaped man is released

together and made sense; they interlocked and gave clues. And they formed a tightening loop of evidence closing in swiftly on a midwestern gang of snatchers.

Thirty-six hours later, as my Pullman rubed through towns on the way back to New York, the last piece of the puzzle had been fitted in place. Newsboys were crying this latest feat of the Federal men. Headlines were telling of another success in the job of making kidnaping "too hot to handle."

"We sit here," Hoover had said. "putting such jigsaw puzzles together. We perform no miracles. But we work hard, we keep on our toes, we use every new development in crime detection that will help us in our work!"

Mark the last point, Gangsters, he be-

lieves, have been able to outdistance the police because law enforcement officers have not kept abreast of criminals in technique. His annual report, citing the sensational achievements of 1933, calls the outstanding development of the year the increased emphasis put upon scientific methods. In fact, so valuable is this phase of the work considered that when the department moves into its new quarters early this summer, the entire top floor of the huge Department of Justice building will be given over to a fingerprint and scientific detection laboratory. Special equipment is being installed for research and experiment.

Ever since the Division took up the trail of the kidnapers, a skeleton staff has been on duty in Washington twenty-four hours a day. A special telephone switchboard and a "kidnap number," National TIT, akis in split-excond communication now listed in directories in various sections of the country as part of the offensive against the santch gangs. In the celebrated Urschel case of Oklahoma, for example, the details of the kidnaping came in over long-distance wires at one o'clock in the morning, ten minutes after the crime was committed. This gave the incrime was committed. This gave the incrime was committed. This gave the incrime the committed of the control of the to be one of the most brilliant feats of crime detection on recent record. Late one Saturday night, Charles F. Urschel, an elderly and wealthy oil man of Oklahoma City, was playing bridge with friends on a screened-in porch at the side of his home. Two men suddenly appeared outside, One carried a machine gun, the other a pistol. They ordered Urschel into a small sedan and sped away.

A few days later, a telegraph messenger delivered a package to one of Urschel's friends in Tulsa, Oklahoma. It contained a letter in the handwriting of the captive and a typewritten note instructing the friend to obtain \$200,000 in used twentydollar Federal Reserve bills and to insert the following advertisement in the Daily Oklahoman: "For Sale: 160 acres of land, good five-room house, deep well. Also cows, tools, tractor. \$3,750.00 for quick sale."

The ad was run and the next day a special delivery letter arrived by airmail from Joplin, Mo. It directed Urschel's friend to pack the money in a light-colored leather bag, take the 10:10 P.M. train for Kansas City, and sit with the bag on the observation platform. He would see a large bonfire on the right side of the track. It was the cue to get ready to throw off the money. He was to toss it to the track immediately after passing a second signal fire. In case of any hitch, he was to register at the Muhlebach Hotel. in Kansas City, as E. E. Kincaid of Little Rock, Ark. As he saw no fires. he went to the hotel where he received a telephone call directing him to walk west on a certain block. He had proceeded only a dozen paces when a man approached, said: "Mr. Kincaid, I will take the bag. The deed to the farm will be delivered within twelve hours," and disappeared around a corner. The next day Urschel was home.

During his imprisonment, Urschel had kept his wits about him. He had no idea of the direction in which his captors had taken him, but was able to estimate roughly the distance he had traveled. Blindfolded with adhesive tape, he had heard guinea hens and hogs outside the house where he was held captive; he had been given water with a strong mineral taste in a tin cup without a handle and he had heard the creaking of a pulley as the water was drawn from the well hear



With this box, the detectives learn to recognize the imprints of different types of shoes

Federal detectives carry in ordinary traveling bags, as at right, complete tool kits for use in scientific police work



Case Illustrates Methods of Federal Detectives







Twice a day, the victim noted, airplanes

Detectives study maps and flying schedules and at last learn where the victim was held

An early morning raid takes the kidnapers by surprise and results in the gang's arrest

the house. But most important of all, he had heard the roar of an airplane engine passing over the house in opposite directions twice a day, at about 9:45 A. M. and 5:45 P. M. One day it stormed and the plane missed its morning run.

Quickly, the agents got in touch with all airlines operating within 600 miles of Oklahoma City. At the office of the American Airways, they discovered its planes had made two trips daily to Fort Worth, Tex. They had been on schedule every day except one. Then the pilot had run into a storm over northern Texas and had swung far to the north. These planes passed near Paradise, Texas, at about the hours noted by Urschel. A further checkup showed that the mother of Kathryn Kelly, wife of the notorious ex-convict, George R. "Machine Gun" Kelly, lived on

a farm near Paradise.
Special agents of the Department of
Justice are adept at seeming what they
aren't. Among them are experts in sixtyfour lines of work and in sixteen sports.
One, dressed as a wandering laborer, risked
his life to visit the farm. While inquiring about work, he noted a well beside the
house and a tin cup without a handle on
the ground nearby. Before he left, he
helped himself to a drink. The well pulley
creates and the water had a strong min-

At dawn, Federal men and police officers swooped down on the farm. Before a man sleeping on a cot in the yard could reach for two automatics and a machine gun which lay beside him, the raiders had him covered. He was Harvey Bailey, one of the most desperate criminals of the Southwest. In his possession was \$700 of the ransom money.

By the time the case was closed, fifteen members of the gang had been sentenced, six to life imprisonment. The government sleuths had followed the trail of the kidnapers through sixteen states and had covered a territory as large as the whole of Central Europe!

The catching of Machine Gun Kelly and his wife was an epic in detective work in itself. For three weeks, the fast-moving Federal men were just one jump behind the fleeing outlaws. On the day before they raced by plane to Memphis, Tenn. and made their catch. Kelly was

reported hiding in five different cities in widely scattered parts of the country.

The government service is organized to track down such rumors at a moment's notice. Every effort is made to save seconds in getting under way. One machine which has figured prominently in most of the cases, is a long black mechanism through which stream perforated cards. Each card represents a noted criminal; each perforation an identifying characteristic.

Thus, if a kidnaping witness reports an unknown snatcher was six feet tall and had a broken nose, the description is flashed to Washington. A few minutes

later, thousands of cards are rushing through the black machine. It kicks out automatically every card standing for an underworld character who is six feet in height and has a nose that has been broken. In thirty minutes, it sorts more cards than a roomful of clerks could run through in a day. And, when this run through in a day. And, when this been narrowed to a bandful.

Reserved for emergencies, is another new mechanical aid. When dial telephones were introduced, it was found that the usual wire- (Continued on page 111)

If a kidnaping victim can describe his captors, this amazing machine will automatically sort out the police records of all known crooks who resemble them, thus narrowing the search







With dial phones, tapping the wire tapping the wire lets detectives hear conversation but does not disclose the number called. With the new device at the left, the number dialed is automatically recorded as Department of Justice men listen in on the telephone messages of crooks who are under investigation



N EVERY horse race there is an invisible entry, an added starter whose name does not appear on the program and who is never seen by the excited race-goers in the grandstand. This entry is a ghost horse, sent to the starting next by vicine.

Man o War, almost any racing man will assure you, is the greatest race horse ever bred in America, the greatest race horse ever bred anywhere in the world. Against his visible thoroughbred rivals, he won twenty of the twenty-one sche he ran in the short course of his two-year racing career. But against the ghost horse he didn't do nearly so well. In nic races, he beat the invisible entry. In twelve races, the ghost horse beat bim!

This ghost horse is science's contribution to the grand old sport of kings, the mathematical Standard Horse against which the relative quality of all race horses of the past, the present, and the future may be checked. Except that he is more scientifically devised and put together, the Standard Horse is to their what Old Man Par is to golf.

Recently, Dr. Harry H. Laughlin, of the Department of Cenetics of the Carnegie Institution of Washington, announced

turn wind On staff rin is to goin of the Department of Genetics of the Carnegie Institution of Washington, announced the results of his ten-year investigation of the racing capacity of the thoroughboth of the The Carnegie Institution, whose interested in horse racing as a sport, nor in the practical aspect of breeding faster horses. Neither, in his scientific capacity, is presented in the course of his long study of the transmission of racing capacity from one generation of horses to another, he has inverted and developed highly valuable scientific tools for the more important study of heredity and the results and developed highly valuable scientific tools for the more important study of heredity in many

tant study of heredity in man.

Dr. Laughlin chose the field of the thoroughbred horse for his investigation because it is a happy hunting ground for the scientist in search of the facts of heredity. Race horses are bred for a single purpose—to run and win races. Ever since, 300 years ago, King Charles II of England sern his master of horse to the Near East to buy the Enb and Turk stallions and racing stock, the breeding records of the thoroughbreds have been kept with extreme accuracy. For more than 150 years in England. and for almost as long in America, racing records

ARTHUR GRAHAME Tells, in this Article, How Speed Performances of Great Thoroughbreds Are Measured by Comparison with a Standard Animal Devised by Involved Formulas

have been kept with the same care. Whether a race horse is a Kentucky Derby winner or a selling plater, digging into the racing records and the stud book will tell you how successful he has proved himself at the job for which he was bred, who his ancestors were, and how successful they were.

Much of Dr. Laughlin's experimental work has been done at

Much of Dr. Laughlin's experimental work has been done at the Mereworth Stud, a Kentucky breeding farm owned by Walter J. Salmon, a wealthy New Yorker who is a keen horseman. Salmon also has contributed generously to the upkerof the Carnegie Institution's laboratory at Cold Spring Harbor, Long Island, where the endless mathematical work demanded by the study has been done.

WHILE a search through the racing records will bring to hard work was necessary to devise a formula by which the worth of these performances od devise a formula by which the worth of these performances could be measured with scientific exactness. It finally was decided that the most nearly accurate results could be obtained by creating a Standard Horse by mathematical calculation of the best racing records, and the comparing the performances of flesh-and-blood horses with the ghost racer.

At first glance it seems that the creation of the Standard Horse should have been an easy task. Equiposies's world record for the mile is 1:34 2-5. That, it would seem, should be the mile time for the Standard Horse. But in measuring racing capacity, factors other than distance run and the time it is run in must be considered. When Equipoise set this record he was four years old, and he carried 128 pounds. What should his time for the mile have been if he had been six years old, and



ries 134 pounds, the Standard Horse will run a six-furlong race at the rate of twelve seconds per furlong. If he is asked to run seven furlongs at that rate of speed per furlong, he will have thirteen and one-half pounds taken off his back, and will carry only 120½ pounds. He will carry that same weight if, when he is the twelve-seconds-per-furlong speed. He's a sportsmanlike animal, that always meets his challengers on even terms.

Having put together this ghost horse to serve as a universal standard for measuring racing capacity, Dr. Laughlin and his assistants tackled the long job of finding out just how real thoroughbreds compare with the ideal race

horse they had developed. To do (Continued on page 116)

if he had carried a lighter burden of only 120 pounds? It was necessary that the Standard Horse should be an elastic racer whose performances would take into account distance, time, age, sex, and weight carried, so that he always would be a fair yardstick for the measurement of the performances of real thoroughbreds running under the varying conditions of actual racing.

THE four main factors affecting the speed of race horses were studied chaustively. Analysis of many hundreds of records showed that, while increasing the length of a race always slows down the average speed of the horses running in it, this slowing-down process is rapid for each furlong, or one-cighth mile, added to the shorter distances, but much less rapid for each furlong added to the longer distances.

Age was found to be an extremely important factor in racing capacity. Race horses improve until they reach a certain age, and then gradually decline in ability. Fillies improve until they are about two and one-half years old, colts until they are four or four and one-half years old, and geldings until they are about five and one-half years old. So there are two ages for a given racing ability in the same horse, a "coming" age and a "going" age.

Analysis of the records showed that in a sprint of

Analysis of the records showed that in a sprint of about half a mile, with the racers carrying 113 pounds, old horses can run as fast as young horses.

For many years race horses have been handicapped by placing weight on their backs; the better a horse is considered, the more weight he is made to carry in a race. Dr. Laughlin agrees with all practical horsemen that putting weight on a horse will slow down his speed. But he doesn't agree with them that taking weight off a horse will make him run faster. Scientific study of the racing records has proved that there is a limit to recasing speed by decreasing weight carried. This may

be caused by the fact that a race horse, like a sailing yacht, needs a certain amount of ballast, or by the fact that small jockeys usually aren't so good race riders as are larger boys.

Taking into account all of these factors and how they interact on one another, the Standard Horse was evolved by a series of complicated mathematical calculations. If he is three and one quarter years old, and he car-

GREATEST
OF THEM ALL
Above, Man o'
War, credited with
being world's
greatest race
horse. He beat the
Standard Horse
nine times out of
twenty-one starts.
Right, newborn
colt whose Futurity Index is based
on the records of
sire and dam and
indicates what





Before the races, jockeys are weighed to determine how much additional weight must be carried by the horses they ride

Railway Mountain Tunnel Brings Water to City



Illustration shows how pioneer tunnel was used in constructing Moffat Tunnel. In the future it will carry water across the Continental Divide

WORKMEN are applying the finishing touches, as this issue goes to press, to a six-mile-long tunnel that pierces the heart of a mountain to bring water to Denver. Colo. The supply will benefit both city dwellers and ranchers in a region where the annual rainfall is less than fourteen inches. and where drinking water, as well as water for irrigation, is now brought through canals for more than 100 miles. Behind the achievement lies a romantic story of an aqueduct that seemed impossible to build. until a quirk of fate handed it over vir-tually ready-made. Tapping snow-fed rivers high on the opposite slope of the continental divide has long been a dream of Denver water engineers, but lofty James Peak towered in the way, a seemingly insuperable obstacle, until the boring of the Moffat Tunnel. To explore the way for this now-completed railway route, men hewed and blasted a smaller pioneer shaft of eight-foot diameter straight through the

Drilling crew at work in the sixmile tunnel that will carry water through mountain to Denver

Retaining dam on Pacific side of Divide that will be used in

turning water into new tunnel

slope will impound the water of the Fraser River and other streams and send it down deep shafts into the water tunnel. gathering enough pressure to

the center of the tunnel and emerge at the eastern portal. A natural ravine will lead the long-sought water to a reservoir near Denver. Surplus water, brought through the mountain, will be stored in the irrigation reservoirs where it will be held for the use of the dry farmers in that region, By ending threats of a water famine, the tun-nel will repay estimated cost of \$3,500,000.

were quick to see that this exploring tunnel, once it had served its purpose, would provide a means of bringing water across the divide. Lined with concrete, it would make an ideal aqueduct. Last January, citizens of Denver voted the necessary funds, and the work is now being rushed to completion. Dams on the Pacific side of the

mountain along a parallel course. Engineers

USE WAX ON PLANES TO INCREASE THEIR SPEED

JUST as a housewife waxes her floors, aviation mechanics apply a periodical coat of wax to the wings and fuselage of the three-mile-a-minute planes on the coast-tocoast route of the United Air Lines, polishing it to a smooth finish with an electric machine as shown above. The odd treatment increases the planes' speed.

NEW RADIO KNIFE SPEEDS OPERATIONS

HIGH-FREQUENCY electric currents are harnessed for medical use in a new instrument devised by Charles F. Brietweiser, research fellow at the California Institute of Technology. The device, perfected after months of research, is described as a radio knife of advanced and compact design. While it operates on a principle similar to that employed in earlier instruments for making clean and bloodless surgical cuts electrically, it is declared to make possible many types of operations not attempted with the apparatus hitherto

New-type radio knife for sur-geons exhibited by its inventor. Charles F. Brietweiser of Cali-fornia Institute of Technology

available





ALUMINUM FLOOR EASES BURDEN ON OLD BRIDGE

WHEN a fifty-one-year-old highway and railway bridge at Pitisburgh, Pa., proved overloaded by modern traffic, city engineers had the alternative of finding a way to lighten the lead or building a new bridge at a cost of nearly \$2.000,000. They solved the problem by ripping out the old steel flooring and replacing it with a new floor of aluminum-alloy girders and plates, thus saving 750 tons' dead weight and the properties of the properties

MECHANICAL LEGS CARRY MANTOWORK

BECAUSE walking to work tired him, a Los Angeles, Calif., inventor constructed from an old bicycle. wooden legs, and old shoes, the mechanical legs seen at right. Perched astride this contrivance, he is able to walk sitting down by turning a pair of foot pedals. which operate the artificial feet through an ingenious crank mechanism. The inventor says the knack of balancing the apparatus is easily acquired.



ELECTRIC TIMER CLOCKS SWIMMING RACE

AN ELECTRIC time: that clocks swimming races in tenths of a scood has been tried out successfully at Columbia University. A switch attached to the starter's gun sets a time clock going at the instant the cartridge explodes. When the swimmer, at the finish of the race, touches a wire grid that hangs in the water, the mechanical contact operates a second switch that stops the timing clock. The latter electric circuit is set in readiness from the main control board as the last lapeigns. The apparatus also announces the winner.





Above, electric timer and the gun that starts it. Left, the device in use to time a match

WATCHES TESTED BY JOLTING MACHINE



Railway watches are shaken in this device to test them

To discover if the watches used by railroad men will withstand the shocks to which they will be subjected in service, officials of one British railway have installed a shaking table to test them. Twelve watches at a time are placed in this device, which is run by an electric motor, and are subjected for fifteen minutes to constant jolting and jarring. Timepieces that are still running after this strenuous treatment are considered satisfactory for use. The device is also used to test small clocks and other instruments that are likely to become inaccurate through rough handling

TROLLEY WIRE OR GASOLINE RUNS BUS

A HYBRID thirtypassenger bus that operates on either its own or trolley-wire power has just been placed in operation at Wechawken, N. J., where a long grade has hitherto slowed service. Going uphill, the bus takes its power from overhead wires and speeds past other traffic at thirty miles an hour. At the top, the driver lowers the poles, and the bus then uses its own gasoline motor.



Big bus equipped so it can get power from trolley wire or its gas motor



CAMERA SNAPS AIRSHIP AT INSTANT OF TAKE-OFF

SNAPPED at its mooring mast during a recent visit to the California coast, the unusual view of the giant airship Macon reproduced above shows the last-minute preparations to cast off. The gangway has been removed and the trapdoor in the ship's hull is about to be closed, while The clocklike dial at the top of the tower is used to signal instructions to the ground crew during the take-off.

COD-LIVER OIL MADE TO TASTE LIKE CANDY

MAKING cod-liver oil taste like candy is the accomplishment of Canadian Government Fisheries research workers. The oil is mixed with coca to form a chocalate-coated confection in which it is said to be impossible to detect its taste or odor, although all the health-giving qualities are retained.



heard for miles resound from this log drum used in the jungles of Africa



NEW PLANE MOTORS

AVIATION engines of a new sectional style, designed with one, two, or four banks of cylinders, have been developed by a Berkeley, Calif., firm, The cylinders are arranged in opposed pairs and operate in such a way that the hollow propeller shaft rotates at half the engine crankshaft speed, without the use of cam shaft gears. Propellers of adjustable pitch, controlled by the pilot while in flight, have been designed especially for use with the new motors. The picture at left shows the first test of one of the new motors.

DRIVER HAS HIGH SEAT IN BIG TRUCK

Because of the difficulty in handling in traffic the large truck shown below, the driver's compartment was elevated to give greater vision. Controls were extended so

occupied by the driver provides additional storage space. The door at the front allows easy access to the load. Rear vision is also wholly unrestricted.





RAYS NOW FEVER TEST

Following the invention of devices that detect the infra-red rays or radiant heat radiated by the human skin, their use is proposed by Dr. Jean Saidman, French physician, as a substitute for a clinical thermometer in taking a patient's temperature. One of the recently developed heat-detecting devices is shown above registering warmth of a girl's face.

RACING CAR. WITH WHALELIKE JAWS, HAS OIL-BURNING ENGINE

Using oil instead of gasoline as fuel, a strange racing car, designed by George Eyston, noted British driver, has already attained speeds of more than 100 miles an hour. Its designer expects to exceed this mark in trials scheduled for the near future. Streamlined and provided with a folding rear deck that, when open, suggests the jaws of a whale, the car is believed to be the fastest of its kind in the world. A 130-horsepower fuel-oil engine of new design provides the power.





ELEVEN MEN CARRY SEISMOGRAPH WIRE

PHILADELPHIANS witnessed a strange procession the other day when a long copper wire was moved from a factory to the Franklin Institute Museum, where it will be installed in a giant seismograph. So sensitive that it could not be allowed to sag, the wire had to be carried by eleven men, walking in single file. It will support a 1.500pound ball and help recordearthquakes.



BIGGEST GOLD NUGGET FOUND IN AUSTRALIA

ALL the gold nuggets that have thrilled lucky prospectors are insignificant beside a giant of which a model is on display at the Smithsonian Institution, at Washington, D. C. Largest ever found, the original weighs 2,195 ounces and is worth a small fortune. It was discovered in Australia in 1858. Photograph shows nugget and twenty-dollar gold piece.

GIANT GLASS TUBE HAS OCTOPUS ARMS



Glass blower fitting an arm to the cooling chamber of a gigantic rectifier tube which will be used in the operation of subway

elaborate vacuum tubes used in modern electrical industry are veritable triumphs of the glass blower's skill. The photograph at left shows a British workman completing a giant tube in the shape of an octopus for installation in one of London's largest power stations. The strange device is a rectifier tube, and will serve the purpose of transforming alternating current into direct current for the operation of one of the city's subways. At the moment the picture was snapped, the mechanic was fitting an arm to the tube.

Some of the

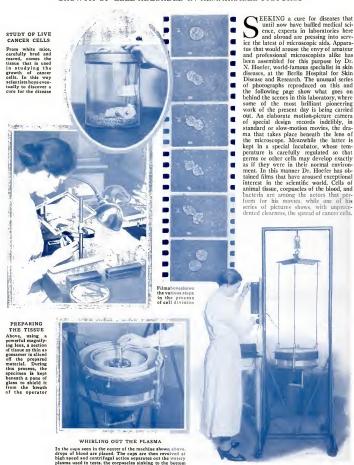


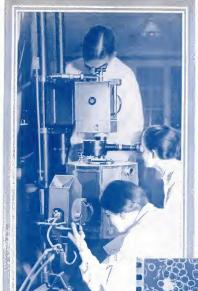
GAS MASK DESIGNED FOR WORKERS ON AIRSHIPS

So WORKMEN may enter the gas-filled bulls of airships, Army experts have designed a special type of breathing mask for them. Shown above, it carries a pair of trailing tubes, and air is pumped through one of these to the worker. The other serves as an exhaust.

Micro-Movies Show Life Secrets

GROWTH OF CELL RECORDED IN REMARKABLE PICTURES





New Way of Photographing Tiny Living Organisms, with a Powerful Lens, Aids the Thrilling Search for Cures of Mysterious Diseases



BIRTH OF NEW CELLS

NEW CELLS
Photomicrograph, left, gives remarkable view of cells in act of dividing. All details are clearly shown, even the tiny connecting filament being visible. This is said to be one of the clearest pictures of this process that has ever been made by scientists



The microscope and the specimen to be photographed are being placed in the incubator. The instrument can be focused from the outside and three persons at once can observe the subject that is being filmed



Glass needles with unbelievably fine points are used in this micro-manipulator to separate out the individual cells beneath the microscope lens

READY TO MAKE A MICRO-MOVIE

In the center of the picture is the incubator in which the microscope and slide bearing the cell to be filmed are placed. At its left, are lamp that illuminates the specimen. The picture is taken through a window in top of incubator. At right, a film of white corpuscles moving through red ones



LIGHT COOLED BY WATER. To prevent the heat of the arc lamp from injuring the specimen, the receptacle seen above is kept filled with water. It is between the light and the incubator

MAY, 1934

Racing Midget Autos

IDGET racing cars. whose drivers sit only four inches from the skid around nine miniature California racing tracks to give the public their newest

speed chills and thrills.

Daring drivers race the tiny speedsters over flat dirt tracks only a fifth of a mile long. Yet on a 300-foot straightaway they attain speeds approaching sixty miles an hour before skidding around flat turns as their wheels churn the earth and the junkpile engines roar their songs of power.

Only during the last year has midget racing been presented to the public. Last August there were eleven of these tiny cars in existence in the West, yet now fifty-six drivers dare death on the abbreviated tracks.

There are no elaborate track layouts, no banked curves, no well-equipped pits





A New Game of Speed,

Left, one of the front-drive racing cars under the excellent workmanship of this homemade car, This kind of finish is typ-ical of most of these baby autos

Below, one of the little machines that has its ongine in the rear. As a re-sult, it looks to be com-ing when its really going Four-cylinder mo-

torcycle engines, set in place like an auto's engine, are used in many of the tiny to supply instant service. Races start and end too quickly to require these luxuries of big-car racing. Just a flat surface, not too smooth; board fences to head off the cars on the curves: a bunch of cars from back-yard workshops and garages, with their dare-devil drivers-and an ambulance. These constitute the full equipment for racing dwarf automobiles.

Discarded motor-cycle engines, outboard motors, and engines from ancient cars provide the power for these sensational racers.

As many as thirty cars participate during a single evening, from single-lap qualifying bursts of speed to the thirty-lap main event. Eight cars take part in the big race of each meeting with terrific flights of speed on the short straightaways, skidding together into the turns only to straighten out and come roaring past the

The whole show takes place almost in the laps of the audience. Never farther than 300 feet from any onlooker, the cars rush by within fifteen feet of those sitting in the front row.

All sorts of cars with all types of controls, from three-speeds forward to single speed with a hand-operated clutch; airplane wheels and wheels cut down from small passenger automobiles; four-wheel brakes; thermo-syphon cooling systems; front-wheel drives-everything a bunch of enthusiasts can bring together rolls by the stands in a single evening.

Bill Brenneman, a ruddy and husky mechanic, leads the pack and so boasts the coveted No. 1 on his car at the end of the first season of racing. Brenneman built one of the few front wheel drive midgets. His good judgment is borne out by his present standing, He has won more races than any other driver.



On a dirt track, only a fifth of a mile in length, the racers hit the curves at 50 miles an hour

Thrills...and Spills!

His speedster is a duplicate in miniature of the famous Miller specials, seen on all tracks where large cars race. He uses a discarded four-cylinder motor-cycle engine with a single speed forward, no reverse and no rear adue. A hand clutch, operated by a lever outside the car, disengages the engine. A podal operates four-wheel brakes. Should Bernneman become involved in a serious crash the car, if upright, will clear the ground after all wheels have been torn away, for a tubular brake spindle with safeties will continue to hold the car up. This daring driver has found what he considers the most expert method of continuing at high speed, even while skidding on the share turns.

"I get probably sixty miles an hour down the straightaway," he told me. "As I hit the turn I ease off on the throttle, ski sideways, then step on her again. The front drive keeps pulling me toward the center of the track, whereas a rear drive tends to cause the back wheels to break traction. That causes many of the accidents.

"Always I try to get as close as possible to a spin on the turns without actually spinning. An experienced driver can 'feel' the right moment to straighten out and give her the gun again. Spins are dangerous If I spin, the other guvs pass me; and if I turn over, they run into me. That's not so funny."

The drivers lean inside as they roar around the curves, watching the inside front wheel. A steady shower of dirt beats them in the face. In fact, the sand and dirt fly back with such power that they blast paint and chronium finish off the metal, requiring complete refinishing every month.

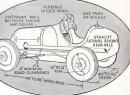
requiring complete refinishing every month.

"Happpy" Woodman, who stands second in the association's list of victories, is another of the veterans. Recently he took his front-drive car out from Los Angeles to Muroc Dry Lake, whose hard sun-baked bed gave him fine opportunity for a speed test. The mechanical clockers recorded 110 miles an hour as he sped over a measured mile. Notches cut across the rough tread of his front tires help provide traction, especially when pulling out from a near-spin.

Woodman attains his great speed with a home-built four-cyl-

B_y Andrew R. Boone

 Illustration below shows the main specifications that must be met by each car entered in a race. The fire-proof wall protects the driver



inder, eight-valve, rocker arm, water-cooled, block in head mounted on a motor-cycle engine base, which turns up 4,000 revolutions a minute at fifty-five miles an hour. He, too, has found the trick of fast driving.

"I feel the tail giving and know just how far to slide before straightening up and going across the curve," he explained.

For the first time there appears on a racing track a car with the engine mounted in the rear. Terry Curley drives this 700-pound novelty. He sits barely four inches from the ground, midway between front and rear axles. Though his car boasts no springs, he nutles over the rough earth in comparative comfort as the car rocks up and down. The body rests on four rubber pads.

Four louvers cut in the cowling immediately behind his back carry air to the fins of his two-cylinder motor-cycle engine.

After breaking a finger when he plunged through a fence at Tracy last summer. Leo Faulkner missed eight race meetings—yet his 1925 Saxon engine, rebuilt many times, pulled him into third place. Faulkner is a veteran of big-car racing, but he finds bumping over the dirt at fifty miles an hour far m. exciting than skimming over the Indianapolis speedway nearly three times that fast.



Cars line up for a standing start. The two men standing behind the driver give the machine a push to help it make a quick get-away



Faulkner has evolved his own novel method of maintaining high speed.

"Fact is," he explained,
"very guy has a different way.
Now take me. I go as far down
the straightaway as I can with
the throttle on, then I let up as
I hit the turn. I cramp the
wheels in, skid about forty feet,
then turn on the gas again."

"Isn't there danger of turning over," I asked.

"Not unless I hit another car," he grinned.

This is sounder reasoning than you may think. The tiny cars lose little speed while skidding and so are able to keep away from those in close pursuit. Their center of gravity is so low and the wheels so strong

there is little likelihood of capsizing unless they make contact with another racer.

another racer. There are exceptions, and tragic they are sometimes. Red Frick slithered around the south turn at Loyola the other night, rolled over, straightened out, and turned end over end. The ever-present ambulance carried him away with serious injuries and probable disfigurement as his reward and probable disfigurement as his reward.

for a few minutes of thrill.

The game draws both veteran pilots and youngsters just out of school. Bill Betteridge, nineteen years old, graduated from high school last year and now is one of the stars with a homemade car rivaling the best in beauty and workmanship. For

The drivers hit the curves at high speed and skid around them, as the tracks in this illustration show

nine months, Betteridge worked every spare hour to build his racer, doing all his own body and machine work.

He is one of the few to utilize an outboard motor, with a three-speed motorcycle gear box adapted to a chain drive. Even with track gear, he has pushed his little red speedster seventy-five miles an hour over a measured course. "With a few changes," he says, "she'll do 120." Betteridge spent S500 in bulding his car, Betteridge spent S500 in bulding his car, Betteridge spent S500 in bulding his car, during his first year of competition. And he's only a half-mile an hour behind the miniature track record of fifteen and ninetenths seconds set recently. The boys spill all over the place as they collide on the turns, spin in the abbreviated straightaways, and lose control while trying to straighten out following a particularly fast turn.

Although the tracks measure only one fifth of a mile, all the cars roll up to fifty-five miles an hour between turns.

I have sat in the stands watching these cars roar around the oval, wondering how the drivers possibly could escape collision and serious, if not fatal, injury as they swept around the sharp curves. The soft dirt covering the flat turns is not exactly conducive to good traction.

Nor do they escape collision. Speed Lockwood recently slipped around the north turn at Loyola, in Los Angeles, straightened out, gathered speed and, exactly in the middle of the straightaway in front of the grand stand, skidded. He spun like a top. Charlie Baker, driving No. 2, smacked into Lockwood's car, which hit the fence.

This incident turned Lockwood's speedster into a "fence crashing fool," as Lockwood expressed it, and during the next five races it ran through fences exactly five times.

There are the control of the control

Few cars have turned over during several score races. In the first of these, Link lost a wheel. Woodman, following close behind, ran over the wheel and his car azoomed from the ground. In a series of bounces, it plunged into the grand stand, finally winding up with all four wheels in the air. Woodman crawled out with lips cut and nose battered. A week later he was racing again.

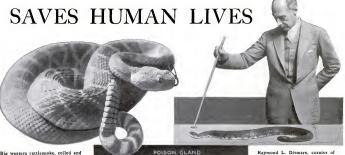
On the north turn at Long Beach, Leo Faulkner felt his steering gear break as he turned into the north curve. The car crossed the track, hit the fence, turned over and caught fire. From fifty miles an hour to a dead stop in a second, yet Faulkner escaped injury.

Dominic Distarce is the car of the midget racers. While older promoters were sitting around thinking about reviving the sport, he went out among California enthusiasts, from San Diego to San Francisco, organized the Midget Auto Racing Asso, (Continued on, page 119)

TAKING CURVE
AT FAST CLIP
The racing cars
crowd each other
closely on the turns,
as is seen in this
picture. As they
skid do dt.
pressionally,
they
created by the control of the control
are so low and so
strong that seldom
do they overturn
and serious accidents are rare



Deadly Snake Poison



Big western rattlesnake, coiled and in position to strike. Note the forked tongue that darts in and out

By

GEORGE COOKE

IGHTING disease with the poison of deadly snakes! That is an amazing new method of treatment reported in recent months by scientists.

The whitish venom of the cobra, the brilliant orange fluid of the water moccasin, and the poison that looks like melted butter and comes from the fangs of the Texas rattler form the strange fluids used in these efforts to cilew our more formation of the company of the company

losis, and epilepsy.

In New York City, Dr.
Samuel M. Peck has been injecting diluted moccasin ven-

om to prevent hemorrhage. Containing 3,000 parts salt water to one part of venom. In solution is injected hypodermically in doses of approximately a fith of a teaspoonful at a time. The only reaction noticed by the patient is a black and blue spot which appears at the point where the injection is made. Some mysterious element in the venom increases the power of the blood to coagulate and stop bleeding.

Since 1930, Dr. Peck has treated 150 cases with excellent results. Even in hemophilia, where the blood of the victim seems lacking in some necessary element so he is likely to bleed to death from a slight injury or even a scratch, the venom treatment shows promise. Other snake poisons have been tried, but the venom of the water moccasin seems best

Illustration shows bead of snake with the shows a show the shows a show the show as a shinged bone and lie flat in mouth

MILKING VENOM FROM A SNAKE a With the moccasin's head held down with a stick, upper left, Ditmars graps it just back of the jaw bones. The distended fangs are then forced through heavy gauze covering the top of a glass into which the poison drains, as shown in the circle. Test tube holds wenom from snake

mammals and reptiles at New York Zoological Park, ready to pin down head of water moccasin

suited for the work. The injections have no effect upon a normal person's circulation.

Speciacular as are these experiments of Dr. Peck, the work of Dr. Adolph Monaelesser is even more sensational. One of the founders of the Reconstruction Hospital in New York City and former surgeon general of the American Red Cross, Dr. Monaelesser has been using modified cobra venom for the relief of cancer sufferers.

While serving as an army surgeon, Dr. Monaelesser discovered the case of a leper who had been bitten by a tarantula. To the surprise of everyone, the venom of the spider brought about a marked improvement in the man's condition. Dr. Monaelesser began studying the effect of minute quantities of various venoms upon the human body and at last gave up his surgical practice and devoted his whole time to the venom treatment of cancer.

One of the first cases in which he used his sensational method was on a man suffering from cancer of the throat. The diluted cobra poison was injected hypodermically in an effort to deaden the
exeruciating pain. Shortly afterwards, the pain subsided and the
cancer itself becam to grow smaller. The

patient, who had been on a liquid diet and had had to sleep upright in a chair, was able to eat solids and lie in bed. Proceeding carefully, Monaelesser, with the coöperation of surgeons here and abroad, has carried on his work. Recently, the results of 200 treatments were reported to the French Academy of Medicine. They showed that in almost every

MAY, 1934



The distended mouth of this reptile shows the fangs that discharge the poison into a wound as the rattler strikes Left, skeleton of cobra, Note

movable ribs that distend the skin to form the hood as the snake rears its head to attack

instance the pain was greatly reduced and when the injections were made after an operation for cancer, there was strong evidence that the venom treatments prevented

In order to secure the venom necessary to save those bitten by poisonous reptiles, snake farms have been established in various parts of the world. Above, the farm at Sao Paulo, Brazil, the first one established

dence that the venom treatments prevented the return of the malady. The injections are made every third or fifth day with a gradually increasing dosage. From Canada comes word that Sir Henry Gray also has used the modified cobra venom at a Montreal hospital with favorable resultal with

ANOTHER series of experiments with a venom cure was recently reported in the British medical journal, The Lancet, At the Port Elizabeth Snake Park, in South Africa, F. W. FitzSimons, the director, has spent several years studying the effect of blending venoms. His work was intended primarily for the treatment of snake-bite victims, But, researches have shown that venene, a preparation formed of several venoms blended together, is of value in epilepsy. It has been widely used in South Africa and a recent paper presented to a scientific society revealed that the results have been highly encouraging.

Before the World War, another com-

Betore the World War, another combination of snake venoms, known as contratoxin, was tested in London, England, by Dr. F. Mehnarto. It was thought to have a solvent action upon certain microbes and was, in fact, tried with apparent benefit in cases of tuberculosis.

Behind the dramatic possibilities of darthese experiments lies the work of daring pioneers who have supplied the deadly poison needed for such medical work, have carried on the task of preparing antivenom, and have taught us what we know about the serpent poisons.

Snake venom, they have shown us, kills through the blood or the nerves. In the case of the water moccasin, the rattler and the fer de lance, it destroys the red corpuscles; almost literally turns the blood to water. The venom of the cobra and coral snake, on the other hand, strikes at the nerves, paralyzes the muscles and at the nerves, paralyzes the muscles and water of the cobra and coral snake, on the other hand, strikes at the nerves, paralyzes the muscles and the nerves the snake, and the snake injects a whitish venom which, unlike the yellow poison of the northern rattler, attacks both blood and nerves. Antivenom which is effective

against its bite is also effective against the venom of a North American rattler, copperhead, or moccasin. But serum capable

of overcoming the poison of the northern

snakes will not prevent death from the

ONE of the first symptoms of a bite by the tropical rattler is a twitching of the hands. Then the victim goes blind. He has to lie flat or choke. The muscles of his neck are paralyzed and his head swings like a ripe apple on a twig. This gives rise to the common belief that the bite of this snake breaks the victim's neck.

Bizarre symptoms also result from the bites of other snakes. The greenish venom of the fer de lance, for instance, causes blood to flow from the victim's cyelids. The fluid of the Texas rattler destroys the tissue of the flesh at the point where the fangs penetrate as effectively as though molten lead were poured upon the spot.

Yet just how these unusual symptoms are produced remains a mystery. Give an analytical chemist the deadliest of venoms and according to Raymond L. Ditmars, curator of the Bronx Zoo, in New

York City, and a foremost authority on the subject, his report will show no trace of poison. In his work with Dr. Monaelesser, Ditmars found that venom is slightly heavier than water and that it is composed of mucus and debris from membrane cells, carbon, sulphur, oxygen, hydrogen, nitrogen, some

fatty matter and salts such as calcium chlorides and phosphates. Yet, every drop of this apparently innocent mixture is more deadly than strychnine though its poison remains hidden.

TO OBTAIN venom for medical and other experiments, Ditmars has milked" thousands of deadly snakes of their poison. At one time, he was extracting the venom from 125 copperheads and moccasins regularly once every two weeks. Sometimes, he would handle a hundred snakes in a couple of hours and during the early work of producing antivenom he once supplied workers with a gallon of the deadly fluid from the fangs of North American reptiles. Much of this work was done in the days before antivenom was available, when the slightest slip was alwaliable, when the slightest slip was alwaliable.

Recently I watched him in this risky work, handling a thick-bodied moccasin on a table in a narrow runway back of the cages in the Bronx snake-house. Turning its blunt head from side to side, its mouth gaping open showing the white lining of its throat, the "cotton-mouth" was wrig-gling back and forth across the flat top of the table. It was fully four feet long. Its curved fangs, like deadly hypodermic needles, were hinged to the roof of its jaws, coming forward as it struck. The teeth of the rattlesnake are fixed to movable upper jawbones like twin stilettos, and fold back when the mouth is closed. Both are hollow to the points, carrying the venom from sacs located above the fangs. The moccasin (Continued on page 118)

New Camera 80,000 Pictures a Second



At top, using the speed camera, capable of taking 80,000 pictures a second, to photograph a falling drop of water. Strip above shows from left to right, the drop hitting the water; 2, the splash it caused; 3, drop reforming; 4 and 5, reformed drop rebounding; 6, falling back again



Above is whirling disk that carries the eight lenses used in speed camera

APABLE of taking as many as 80,000 pictures in a single second, a superspeed movie camera has been developed in Germany for industrial research. At such speeds, a drop of water falling into a basin is simple to photograph, and even the filming of an electric fuse as it burns out, showing the individual falling drops of molten metal, does not overtax the capacity of the remarkable instrument. Its use in the study of high-speed electrical and mechanical devices in actual operation is expected to solve long-standing problems of design, since the oscillations of a spring or the action of a valve may thus be clearly recorded. Instead of the single lens of ordinary motion picture cameras, the new instrument has eight separate lenses, which are mounted on a circular disk that is revolved at high speed by an electric motor. A second whirling disk,



The series of views above show, from bottom to top, electric fuse burning out

pierced with rows of perforations, serves as a shutter. Each row contains eight perforations, one corresponding to each lens and allowing an image to be registered on



Revolving shutter with rows of eight perforations, which correspond to the lenses

a certain section of the moving film. The arrangement is such that in the time ordinarily consumed in making a single picture of frame, as many as eight pictures may be registered on subdivided parts of the film by the spinning shutter-lens combination. By this ingenious method of can attain its extraordinary speed without requiring the velocity of the moving film to be raised to a prohibitive figure.

ANTI-AIRCRAFT GUNS IN TREE TOPS



METHODS of air defense peculiarly suited to the tropics have been devised by Army men in the Philippine Islands, where guyed poles support among the tree tops anti-aircraft machine-gun nests like the one illustrated at left. Thus a clear field of fire is provided, while the theory of the control of the provided of the pro



CELLOPHANE PROTECTS RARE STAMPS

FLAT tubes of transparent cellophane, gummed at the upper edge, now aid stamp collectors in mounting their specimens. A stamp is slipped into the tube and the desired length is snipped off as illustrated. The tube protects its contents from moisture in the air.

PORTABLE EQUIPMENT MAKES

Whole World



Movie A Studio



With a portable outfit a sound

A native of the South Sea islands serves as property man and camouflages a microphone with bananas to hide it while scenes are shot

By JOHN E. LODGE

NVENTORS of Hollywood are turning jungles, South Sea Islands, and icy wastes of the north into sets for the latest talkies. Thanks to their recent innovations, full-length features are now being produced, complete with sound, thousands of miles from the conveniences of the studio.

In the days of the silent pictures, a roving cameraman needed only a camera and plenty of film. With the coming of the talkies, all that changed. Soundproof studios had to be built and tons of equipment preceded a company on location. Now, however, by simplifying the sound apparatus, substituting duralumin for heavier metals, employing new type re-flectors, and designing "break down" gen-erators, technicians have reduced the weight of the equipment needed. Two men can set out today and search the far corners of the earth for screen drama with a complete outfit for recording it packed in a couple of trunks and a few small boxes.

One such two-man company recently shipped back from the South Seas 40,-000 feet of film, sealed in 200 tins, to form the backbone of the feature picture, "The Sea Girl." James B. Shackelford and George Dromgold were the men who



Here is all the equipment needed to take sound pictures: camera, microphone, amplifiers, battery

journeyed to the East Indies to get the film, The story of the handicaps they over-came and of the impromptu inventions they made illustrates the ingenuity required of these cameramen adventurers.

On one location, for instance, Shackelford found his supply of distilled water running low. "To avoid costly mistakes," he told me, "we always use distilled water in developing the films. Neither in the tropics nor on the desert can we be sure our water supply is free from alkali and

Instead of fretting over the situation or waiting for bottled water to arrive from a distant port, Shackelford coiled thirty feet of copper tubing in a five-gallon gasoline can, attached one end to a two-gallon oil can and ran the other into a milk bottle. He then filled the two cans with water and his homemade still was ready for action. By turning a blow torch against the two-gallon can, he was able to create enough steam to condense two quarts of distilled water every hour!

During one scene, the men found they needed some means of turning quickly when making running shots in close quarters in the forest. So they devised a three-wheeled dolly which rolled silently along on three planks laid through the heavy growth. At the end of the planks, both camera and sound apparatus could be swung around in its own length by one man, ready to continue the thrilling chase.

Complete with portable batteries, which operate the camera and soundrecording mechanism, such outfits weigh less than 250 pounds. They are so simple that Polynesian natives, who had never seen a movie camera before, were able to operate them, pushing buttons to start and stop them at signals from the busy movie men. In fact, three of these portable cameras, with

a separate circuit for the microphones, recorded scenes at New Guinea just as faithfully as the intricate equipment of a giant Hollywood studio brings sights and sounds to the screen.

Two ribbons of duralumin vibrating in a magic black box bolted to the rear of a magic black box botted to the rear of the camera do much to make such feats possible. It is the black box, known as a modulator unit, which recently has elim-inated many of the difficulties of sound recording.

Complete, the box weighs only three pounds. It consists of two lenses, a light valve, light, and magnet. All that is needed to run the device is a six-volt battery which can be recharged easily. In an emergency, an automobile battery will do. The cameraman bolts this modulator

unit over an opening at the rear of his camera. The two ribbons operate in a



Below, fastening palm leaves to an electric light pole in Elevala, Papua, to make it look like the native scenery

picture is shot with genuine Hawaiian scenery as a realistic background

Sound and Picture Outfit Now Carried to Any Spot, Complete for Work, in Two Trunks and a Few Boxes

magnetic field. They move apart or come together as the sound current varies. Light, coming from the camera lens, passes between them and reaches the sound track of the film in varying amounts. This variation produces the wavy line which records the sounds picked up by the microphone.

Pictures and sounds are recorded on separate films which roll through the cameras at a constant speed of ninety feet a second. This permits them to be cut and matched when the experts in the Hollywood cutting room begin their work of assembling the completed picture. To increase the fidelity and range of sound repro-

and range of sound reproduction, another innovation was recently made. It enables the roving director to catch exectly the different shadown of sound that occution. It is known as the bilateral sound track. This means that the light creates waves on both sides of the marrow celluloid track instead of on a single side a in the past.

During a recent tropical jaunt, another cameraman, Karl Struss, discovered that, with the nearly silent cam-

eras now in use, the 350-pound "ice-boxes" used in the studios to shut in the sound are unnecessary. He flung a canvas cover over

his apparatus and found it was adequate to kill the faint clicking of the modulator unit. Sometimes the

Sometimes the picture-makers in faraway places move headquarters daily, searching for unusual native characters and scenic backgrounds. Shackelford, for example, sometimes of the picture of the picture

New Guinea, the location he was looking for. Maps, several wandering directors have told me, prove inadequate on such trips, often showing points 150 miles from their geographic locations. Consequently, they make it a habit to take bearings from the sun and stars and to check their watches regularly from signals broadcast by radio,

In the Arctic, the cold makes the film used in the cameras britlet; in the tropics, the humidity brings out the grain and shrinks the film unless preventive steps are taken. Sometimes in the tropics, the celluloid strips actually go limp in the cameras. Shackelford discovered that by dehydrating the film with calcium chloride he could preserve it easily and by sealing it again and returning it by carly boat to Hollywood, he could make sure his costly drama would reach the screen.

One unexpected complication in filming "The Sea Girl" was a telephone pole in New Guinea. The town of Elevala, on the south coast, had been chosen as an ideal setting for a scene. Some time before, the pole with an electric light attached had been set (Continued on page 113)



BIG GAME TROPHIES USED TO MAKE UNUSUAL FURNITURE

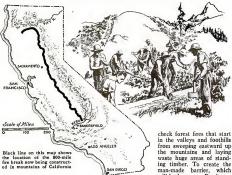


BY TURNING big game trophies into furniture, a New York designer has created a new and original style of craftsmanship. Elephants provide him with a variety of materials, as shown by the accompanying photographs. Four tusks, matched and mounted, serve as the posts for a bed, and a section of elephant hide provides a top for a taboret. The stuffed foot of an elephant becomes a smoking stand.



New style is set in furniture by using the tusks of clephants as posts for a bed. The photo above shows the designer of the unique furniture attaching the tusks to the frame

BIGGEST FIRE BREAK 800 MILES LONG



CALLED the greatest single project of its kind ever attempted, a monster fire break 800 miles long is being constructed on the western slope of the Sierra Nevada Mountains of California by the U. S. Forest Service. When completed, it will

man-made barrier, which will be known as Ponderosa Conservation Corps are clearing all inflammable brush from about two thirds of a billion square feet of virgin forest land, and cutting away the lower limbs of

standing timber.

PRESSURE SHARPENS MECHANICAL PENCIL

To SHARPEN it, the user of a new mechanical pencil has merely to press its tip against a table-top. When the pressure is released, a spring clutch automatically thrusts the lead forward and then locks it. The pencil is provided with a pocket clip which is extended by twisting the barrel. When tripped, it snaps down upon the edge of the pocket.







MAP-READING DEVICE AIDS ARMY GUNNERS

As ax aid in visualizing the contour of the ground from a map, a quickly read indicator has been devised for military and other uses by H. G. Hamilton, of Des Moines, Iowa. In use, the device is placed directly on the map as shown in the upper view. By moving the adjustable pointers, shown in the lower picture, to the proper elevations on a vertical scale, an accurate representation of the profile of the ground is instantly obtained. Thus crue to be proper problems, and may also be used by surveyors in plotting road cross sections and the vertical variations of a traverse.

Laborer Finds \$315,000 Diamond



The fourth largest diamond ever found has just been unearthed in Africa. It weighs 726 carats and won its owner a fortune

DIAMOND history was made recently when a native laborer discovered a flaw-less blue-white diamond weighing 726 carats on the diggings of J. J. Jonker, a poor prospector, at Elandsfontein. South Africa. Large as a hen's egg, the stone was immediately bought by a diamond firm for \$\$15.000, with a part of which the lucky sixty-two-year-old prospector planned to realize his life's ambition of buying a sheep and cattle ranch. Only the control of the discovery of the control of the contr

hope of similar discoveries. Two general methods are in use for mining the gens. In many parts of South Africa they occur in river gravel, which is washed and screened. Most of the diamonds of commerce, however, come from the curious volcanic pipes of blue commerce, however, come from the curious volcanic pipes of blue diggings. Here deep shafts are driven, the earth being brought to the surface and washed.



At top, screening river gravel to recover diamonds it may contain. Above, inclined table at which native laborers sort out the small diamonds from the gravel

MOLD FOR BIGGEST TELESCOPE MIRROR

Above, 120-inch trial mirror, poured to test method to be used for casting the big 200-inch mirror. Right, mold for world's biggest mirror. The knobs form ribs and the high center leaves a hole for optical uses TWENTY tons of molten glass were ready to be poured, at this writing, to form the largest astronomical mirror in the world for the California Institute of Technology's 200-inch telescope. For the casting of the huge mirror, experts of the Corning, N. Y., glass works have prepared a mold seventeen feet in diameter and studded with a curious pattern of projecting knobs. A cylindrical projection at the center will leave a hole for optical purposes. The surrounding knobs will produce a pattern of strengthening ribs on its under side.





WHIRLING NEON LIGHTS HELP FLYERS IN FOG

BY INSERTING two neon light tubes in the ends of a small wind-driven propeller, a new type of for-penetrating light has been created for use on planes. Miniatures of the device have been installed in the and are now being tested. When two planes approach, a red or green light is seen on each wing. By using a cone on the ground a shaft of light may be projected to guide pilots in a fog.

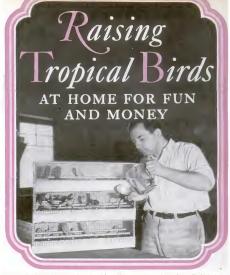


By Frank Flowers

Conditions Under Which Feathered Pets Will Thrive Are Described by Expert

EEP in the heart of India, runners search the forests for Spice Finches, that their modest colors on the fringe of another distant forest, Australia's national bird, the kookaburra or laughing jackass, tries vainly to evade the net of his would-be captor, little thinking that one day he will mock an American owner. The tou-can projects his jutting probost's and scolds unwanted visitors in his South American home. In China the man-made Society Finch, which knows no wild an-acestors, struts and chirps as he rears numerous families.

From the grassy plains and forests of tropical regions, many rare and beautiful birds have been delivered to American homes. During the last few years home breeding of these feathered beauties, many of them comparatively unknown a decade ago, has attained the proportions of big husiness. These little creatures thrive happily in capitivity, living to an age which beautiful the forces of nature than the proportions of the comparative to the control of th



In these tiny boxes, birds may be shipped long distances with perfect safety. Their food is placed on the bottom of the boxes and their nonspillable cups are filled with water each day

These strangers may be rearred easily by the amateur bird fancier. Generally the rules applying to one variety are suitable for any other. Whether your interest runs to exotic unknowns or to the parrot, finch, or canny types, you will find them easy to breed and raise provided you observe a few simple suggesions and keep them warm, clean, and properly fed.

You may choose from a wide range of color combinations and varieties. There are more than 200 types of finches alone. Possibly a parrot-type bird interests you.

Though the originals reached American shores from Australia, the Shell Parra-keet, known also as the love bird, is by all odds the most popular today. The parrakeet's engaging mannerisms, hardiness, and free-mating propensities make it an ideal subject for breeding.

The Mexican red cardinal, kookaburra,

The Mexican red cardinal, kookaburra, and the toucan may object to entering captivity, yet, like all birds, they soon settle down to domestic felicity and in due course will reward their owner by bringing young into the world. The kookaburra is very rare in this country. I know of only one pair. These are hardy one pairs these are hardy shores in good health after the long voyage from their native land.

I have known many "queer birds" but none stranger than the toucan, whose long beak looks as though it would pull him off balance without warning. He gets along nicely, however, both afoot and on the wing; and with proper feeding and care will make life interesting for his owner.

Like the toucan, most birds now gracing private cages and aviaries are tropical in origin, yet some of them have been known so long that people think of them as native to this country. For over a halfcentury the Shell Parrakeet has been one



Illustration showing dimensions and general appearance of a fourteen-foot aviary that is ideal for breeding birds. A partition lengthwise makes it capable of housing two families

of the most popular birds for cage and aviary. This variety probably outnumbers all others of the parrot family.

Every owner wants his bird family to multiply. To insure this select unrelated stock. You will find it pays to obtain the finest available. Otherwise the second and third generations may revert to scrawny types, unlovely and frail.

Success with your birds depends largely on proper and saniary surroundings. You must decide whether an out-of-door aviary or an indoor cage will be used. Fortunately it is wholly unnecessary to invest a large sum in expensive equipment for either type of home, whether you are planning the domicile of a single pair of the planning the domicile of a single pair of derive your pleasure in planning and building your own breeding cage or aviary.

and in tending your little flock once it arrives.

Home-built aviaries are surprisingly simple and inexpensive. For the small, in-door aviary, first make a base by nailing onto two timbers measuring one and three-fourth inches by three-fourths inch a three-ply veneer board eighteen inches by twenty-four inches. Then complete the frame of the box-like structure to fit overall specifications of twenty-four inches in height by a width of twenty-four inches and a depth of eighteen inches. Cover each side with one-half inch-square meshwire fabric, painted green for better visibility. Nail a piece three-fourths inch by three-fourths inch in front over the pan. to which the wire fabric is securely nailed above the pan. For a door, cut an opening three inches by four inches in the fabric in the exact center of the front, hanging a piece of wire fabric four inches by five inches over the opening so as to swing outward. The pan, of galvanized sheeting, should fit the floor of the cage.

The outdoor aviary may be varied in architecture and yet present the essential features. Such an aviary will protect the birds adequately against cold weather. An aviary large enough for fifteen pairs of finches or ten pairs of finches or ten pairs of for fifteen pairs of finches or ten pairs of finches or finches or fifteen pairs of finches or ten pairs of the pairs of finches or fifteen pairs of fifteen pa

is eight feet long. In sections visited by heavy snows, the roof should be pitched

to an angle of forty-five degrees.
Solid roof should extend three feet from the house out over the screened section to protect the flight entrance against rain and snow. No other formal instructions need be followed other than to build the outer part of light materials and small-meshed screen, to extend about eight feet from the house. An aviary of this size is ideal for any small birds, but it is best not to mix varieties for safety in seeding. By running a partition length in seeding, By running a partition lengther than the same properties of the same properties.

Green shrubs, when planted in the light, make the aviary more attractive. The birds appreciate it. Whenever possible, use rustic boughs for perches instead of milled lumber, as they are more ornamental and make the birds feel more at home. Always hang the nest boxes in the enclosed section,

Close the birds up at night in both summer and winter, as stray cats bother them if they are left in the open flight. Keep the ground covered with clean dirt or sand to avoid disease. You may keep the feed hopper on a shelf under the window in the enclosed part so the birds will have plenty of light on their seed.

You need not build a formal aviary, however. Many people of my acquaint-ance use spare rooms and screen porches by placing wire netting over the windows and sand on the floor. Other suitable places are the attics of houses or barn and the flat roof of an apartment house.

If possible, arrange some means of watching your birds, unobserved, at play, In our bird sanctuary at Reseda, Calif., I can observe most of our 10,000 beauties through dual peep holes in the walls of the breeding aviaries. Each pair of peep-

ers is shielded by a metal flange, which gives them the appearance of the old-fashioned steropticon. One doesn't enjoy birds till he sees them, not through a show (Continued on page 120)

Below is the right kind of a box nest for love birds. Here one is seen taking its first look at the world. The nests may be built of waste hoards



Baby finches like this

one can be tamed to rest on the finger if

they are carefully handled while young







This gourd has been turned into a nest for a love bird. Such nests are ideal and furnish good protection



If a bird suffers a broken leg, it will generally heal rapidly if quills are cut the proper length and used as splints to hold the bones in place

MYSTERIOUS SEA MONSTER FOUND DEAD

CAST up dead on the shore near Cherbourg, France, a strange sea animal with a head like a camel, a long neck, two shoulder fins, and a split tail has provided a puzzle for scientist. Its length of twenty-five feet entitles it to be described as a sea monster, while its shape resembles that of no known species. The carcass was mutilated by

waves and sea birds soon after being washed ashore. Fortunately, the first arrivals at the scene obtained photographs that may aid scientists in classifying the new monster which is now being dissected.



RENEWABLE CLEANING STRIP IN NEW TOOL

USEFUL for dry-cleaning sucde shoes, or for sanding wood surfaces, is a new tool that uses a renewable strip of abrasive. The strip is fed from a central roll around the circumference of the block, and is clamped at the ends for use. When it is worn a new strip is pulled into place.



Twenty-five-foot sea monster that was cast up dead on the shores of France. It had a head like a camel, a long neck, and a split tail. Scientists are dissecting it but thus far have failed to classify the creature

BLACK LIGHT GUARDS BABY

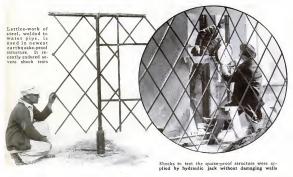
DESIGNED to foil would-be kidnapers, a baby's crib, guarded by rays of invisible light, was exhibited recently in Chicago. Draperies at the foot of the bed conceal a lamp producing black light. Its rays are focused upon a sensitive electric eye. When the baby is lifted, a bell rings.





Above, concealed relay that operates alarm on baby crib. Left, bell rings if baby is lifted

EARTHQUAKE-PROOF STRUCTURE WITHSTANDS HARD SHOCKS



A NINE-by-fourteen-foot test wall, complete with door and window, embody-ing a new form of earthquake-proof construction suitable for houses and schools, has just undergone successful trials at the California Institute of Technology. The trial section, employing a diagonal lattice-work of steel electrically welded to a framework of steel water pipe set in concrete, was declared virtually undamaged when a hydraulic jack applied the sever-est shocks ever given a full-sized wall panel of any material. The new system is said to be economical.

TAILLESS FLIVVER PLANE HAS PUSHER PROPELLER

SUCCESSPUE In its first flying tests, a tailless plane, to be manufactured at a price within the reach of any aviation enthusiast, has been designed by Waldo D. Waterman, former air-mail pilot and veteran airman of Santa Monica, Calif. The odd machine seats two persons and is said to have flown at more than 100 miles an hour. The power plant is a lightweight radial motor of air-cooled type, operating a pusher propeller at the rear of the craft between the V-shaped wings.



New tailless, pusher-propeller type plane caught by camera during a test flight. It is said to attain a speed of 100 miles an hour

At left, view of tailless craft which has been designed to meet popular demand for a cheap and safe plane

STALACTITES FORM IN OLDEST SUBWAY

USUALLY associated with caves of great age, stalactites are now forming in a subway tunnel in London, England, and provide a geological curiosity for visitors to this old shaft. The tunnel was used for the world's first subway. built in 1890, and carried its last train thirtyfive year ago. Meanwhile water seeping into the tunnel from limestone beds above has created iciclelike pendants that become longer each year forming beautiful stalactites.





SOAP-BUBBLE GLASS IN ULTRA-VIOLET BULB

THOUGH ultra-violet light will not penetrate ordinary window glass, it passes with ease through the window of glass only two ten-thousandths of an inch thick in a new lamp bulb for home use designed by Westinghouse engineers and shown above. Thin as a soap bubble the window does not break because of its surrounding support of standard glass.



RIBBED RUBBER GLOVES HOLD DISHES SECURELY

HOUSEWIVES who wear rubber gloves while washing dishes may now obtain a new style with non-skid fingertips. Rough-surfaced rubber gives a firm grip on glasses or dishes, as shown in the illustration above, reducing the danger that they will slip from the hand.

NEW CONSTRUCTION SET HAS MANY USES

Any voungster can make his own parts for constructing miniature buildings, railways, and derricks. with a construction set just placed on the market. Flat steel strips serve as the material. These are cut, punched with holes, or bent into a variety of shapes by a versatile combination tool supplied with the outfit. The tool also cuts and threads bolts. wire, or axles. According to the maker, a boy may thus assemble an unlimited variety of models along his own plans, without being cramped by the limitations of ready-made parts of buildings.



Construction kit, containing flat steel strips and a tool with which to bend material, makes the building of many toys easy

Slanted Oil Wells



The large-toothed circle in the photo above is the rotary table that grips the drill pipe and imparts a turning motion to the bit. By tilting this table, the well can be deflected right from the start

By Sterling Gleason

LANTED oil wells are the latest sensation of the oil industry. Drilled by experts who use special tools and secret methods to send the bit burrowing into the ground at strange angles, they are finding amazing new applications. They are being used to harness wild wells that cannot be controlled from above; to turn the bit aside when tools have become stuck in the hole, and to tap subterranean pools lying beneath deep lakes or inaccessible peaks. In the hands used secretly to cross property lines and filch statt-owned oil lying beneath the floor of the ocean.

Only a handful of men in the world have the strange power to make a bit, rotating a mile below ground at the end of a steel drillpipe, snake its way in a curve or around a dog-leg angle, to reach a desired objective. Their wizardry is made possible by the use of new scientific eyes that see what the bit is doing and telegraph the information to the surface; by universal-jointed bits that feel their way around curves; by robots that automatically control weight, on the bit automatically control weight, on the bit and the straight or making it worm its way off on a new slant. Add-filled bottles plunge downward to sound the depths of tilted holes, Automatic cameras, controlled by

Strange Tools Revolutionize Drilling and Open Way to Development of Fields Under Mountains or Beneath Sea's Floor

gyroscopes, travel into the depths of wells, snapping pictures and charting the well as they go toward the bottom.

go toward the bottom.

Brilliant work by a specialist in the new science of directional drilling, has just saved a whole oil field from ruin. A spectacular wild well was spouting located to the special special control of the special speci

The trouble began when gas pressure from below, seeping up around the pipe, suddenly erupted to blow a funnel-shaped hole around the well casing. A torrent of mud and water followed. Before oil men could get

to the runaway well, they saw the whole derrick, with its Christmas tree of pipe fittings and valves, vanish into a cauldron of mud water and oil

of mud, water, and oil.

Crews dragged the crater with wire lines
but could not reach the valves. Meanwhile the hole had widened into a seething crater more than 150 feet in diameter.
Oil at the rate of seven thousand barrels
a day overflowed to form a huge, oiltopped lake nearly fif-

teen acres in area and still spreading.

Major oil compa-nies who owned surrounding properties were alarmed. Their own wells, beaned down to a small production under order of the State Railroad Commission, were be-ing robbed of their share by the runaway well. An enormous quantity of gas, es-caping into the air. was rapidly running down the pressure of the field like a punctured automobile tire. Meanwhile, heavy clouds of gasoline-laden vapors swept over the whole district, carrying a threat of fire.

The Humble Petro-

leum Company invited other operators to join them in a desperate attempt to check the wild well. For \$500,000, they bought the lease, crater and all. The drillers could have all the oil they could salvage until the well was brought under control. Already they had skimmed more than a million dollars' worth from the surface of the pond.

What to be a serial this valuable elephant? Company coperts had no feasible scheme. From Long Beach Calli, they summoned H. John Eastman, diational chilling expert, who proposed a dartional chilling expert, who proposed a darting the care, and by the use of mechanical deflectors, would start a new well near the care, and by the use of mechanical deflectors, would throw it within a 100-foot circle drawn around the bottom of the runaway well. Then mud or water could be pumped in to choke the gas pressure and shut off the flow of oil.

It seemed a wild venture, but it was the only hope. The Humble Company placed an expert crew of drillers at

MEASURING THE SLANT OF A WELL AS IT IS DRILLED



Work New Marvels



NEW TOOLS USED IN SLANTING WELLS. In center above is whipstock, cut-away to show how it deflects bit. At its right is the universal joint used to follow hole on new slant. Above is tilting turntable that can be set at any angle. Upper left, well that stopped runsely.

Eastman's disposal with orders to follow his instructions.

In the toolhouse of Alexander No. 1, he found the record of an old acid-bottle survey, made when the well was being drilled. The hole was almost perfectly vertical. With the aid of simple geometry, Eastman sketched a plan. He would sink a straight hole part way, then drift side-wise in an arc, intersecting the oil formation close to the wild well.

Four hundred feet from the crater, Eastman started his relief well. To guard against fire, a huge, sheet-iron shield was built between the well and the crater. Foam generators were set up on all sides, with nozzles trained upon the crater.

When the drill reached the depth of 1,960 feet, it was pulled up, and down into the hole went another instrument. Below its cutting teeth was attached a piece of pipe cut diagonally along its length, on a siant. Drillers carefully lowered it until it fatted the bottom of the hole. Then the sianting surface of the beveled pipe, it was deflected, starting a new hole at an angle toward the runway with the mangle toward the mang

Twenty feet more, and the deflecting tool was removed. Into the hole went a single-shot surveying instrument of Eastman's own invention. As it his hottom, a miniature camera within the instrument clicked, photographing the position of a compass needle and a spirit-level bubble. Twenty minutes later, Eastman was reading the position of the hole from this record. It checked exactly with his plan.

Into the hole now went a universaljointed bit, which readily followed the new slant that had been established Every 100 feet, another survey was made, to be sure the bit was drifting in the right direction.

Dexterous control brought the hole along a curve to the depth of 4,800 feet, where the required drift was obtained. Again Eastman caused the bit to swerve like a live thing, plunging straight down to 5,135 feet. Here, at last, it struck the oil formation

The drill was pulled up, casing set in place, and a battery of powerful pumps began to force water down under tremendous pressure. For a time the well seemed to resist the flow. Suddenly something gave way, and the fluid began to run rapidly into the ground, It had broken its way into the subterranean cavern whence oil had been removed by the wild well that was still active.

Within a few hours, the flood of oil ceased spouting from the crater. Eastman's relief well had done its work.

The crater could now be drained, the lost Christmas tree raised, and the well restored to orderly production.

Strangely, the new science of slant drilling originated through science's efforts to drill oil wells straighter. Wells used to wander far from (Continued on page 117) By means of cover-glass drawing attachment and transparent millimeter scale, you can find the magnifying power of your microscope. First measure a small object under low power. Then use this measurement to calibrate other higher magnifications

STRANGE PLANTS you can see



In Microscope Gardens

In circle, highly magnifed years may be a second of the plays an important part in industry. Below form of micro-garden. A years dropped late second of molesses water of mole

Photomicrographic view of dust-garden bacteria that cling together in little clusters. They can be seen at 100 diameters when stained. At a higher power, the individual bacteria will become plainly visible

By MORTON C. WALLING

AISING prize roses or chrysauther murns given or greatent and the capacity of the matter microscopist who establishes a micro garden. This wonderland is a covered dish; the soil is a specially prepared gelatin or agar, and the seeds are tiny bits of living dust that are floating dust that are floating

in the air of your home, in theaters, and almost everywhere. It costs but a few cents to establish several dust gardens.

A petri dish is ideal for your garden, but you can use a saucer or other shallow dish covered with a plate of glass. The dish and cover must be sterilized well before planting. You can do this by placing them in a cold oven, raising the temperature gradually to a point where white paper will be scorched, and keeping it there for a half-hour; or you can steam them in a kitchen cooker for two or three hours. The idea is to kill all of the little plants that may be adhering to the dish and cover. When the process is complete, remove the dish and cover, and let them cool. Then you are ready to add the sterilized soil.

The soil, consisting of nutrient agar or gelatin, can be purchased ready-made ready-made at drug stores that sell laboratory supplies. It comes sealed in tubes, and is simply added to the dish, diluted, if necessary, with sterilized water. However, you with sterilized water. However, you soil from easily obtained material.

Obtain a quarter-pound of beefsteak and chop it into small pieces. Pour a cup of cold water over it, and bring slowly to a boil. Cook for about fifteen minutes. Add about one-fifth teaspoonful of baking soda (sodium bicarbonate) to the broth.

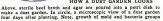
You can use either granulated gelatin or agar, a seawed preparation, to give body to the soil. Place three tablespoonfuls of either the gelatin or agar in a cup and moisten with water. Then add this to the beef borth and boil for several minutes, until all of the gelatin or agar is a cup dissolved. Remove the mixture from the fire and filter it through absorbent cotton or several thicknesses of wet flannel or other cloth. Pour into a pint milk bottle or similar container, previously heated to prevent breakage. Cork the bottle with a wad of cotton.

Although it is not likely that there will be many living microscopic seeds in the soil, it is best to make sure there are none. To do this place the bottle of nutrient gelatin or agar after cooling for a day, in a pan of cold water, using enough water to come within an inch of both the seed of the seed of

When the soil has cooled to a point where the container can be held in the fingers, lift the cover from one of the sterilized dishes, remove the cotton cork from the bottle, and quickly pour into the dish enough of the mixture to form a thin layer. Let it harden. Your micro garden now is ready for planting.

This planting process consists merely of placing the dish in a room and letting it remain uncovered for fifteen to thirty minutes. If the room has been swept with a broom a few minutes before the dish is exposed, you need leave the cover off for only two or three minutes. It is interesting to take a dish to a theater and uncover it for several minutes, and later determine what kinds of living





things found in the playhouse atmosphere. Set the freshly planted garden in a warm place. A day later, you ought to detect one or more spots made up of irregular filaments. These are molds. Another day, and you will find several small, shiny specks on the soil surface. Some are orange, some yellow, others white, and perhaps still others are ivory colored. These are colonies of bacteria. Each shiny spot started from a single germ that fell upon the soil from the atmosphere while the cover was off. You would have encountered difficulty finding and examining that single germ even with a high-powered microscope. But because the original seed found the soil of your micro garden nourishing and the temperature sufficiently warm, it started growing. Soon it had divided into two separate microbes. Then each of these had divided to form four. Then there were eight, sixteen, thirty-two, and so on until the colony hecame large enough for you to see, in spite of the

VEN if you had no microscope, you EVEN II you had no micro-garden interesting. By planting gardens under various conditions, you can determine with fair accuracy just how germ-laden the atmos-phere is. You can prove that the house-hold broom is one of the least efficient of cleaning implements because it stirs up dust plants and causes them to fly about in the air and settle on food and dishes. It becomes obvious why food should be covered when left on the table. You can demonstrate that the dust stirred up hy a broom requires two hours or so to settle, so that dusting of furniture should be delayed as long as possible after sweeping; and that a dampened broom or dust cloth is less offending than a dry one,

great number that died.

These microscopic plants generally are

harmless under normal conditions. You inhale bacteria and mold spores with every breath, and think nothing of it. However, you may capture an occasional disease germ in your micro garden. For that reason, you must exercise care in handling the colonies. Do not touch them with your fingers. When you are through with your investigations, place the garden, slides, cover glasses, instruments, and

whatever else came in contact with the hacteria, in water and boil for at least two hours. The water should contain washing soda, about a tablespoonful to the gallon. This process kills the plants and renders harmless those which already were not that way.

Perhaps you have thought it would be usless for you to try to see bacteria with your microscope. Such a thing, however, is entirely possible and easy, if you have an instrument that magnifies 300 to 500 diameters, as many amateur microscopes do. Some of the round, shiny, yellow plant heds in your micro garden prohably are composed of hacteria which go by the musical name of Sarcina lutea. These micro-organisms look for all the world like tiny, cuhe-shaped Christmas packages tied with string. That is because, in reproducing, they divide in three dimensions and the individuals hang together in groups,

One way of ohserving S. lutea is to arrange a hanging drop. With the point of a dissecting needle, remove a speck of the

Above, diagram showing how to make a hanging drop cell so you can see inside the water. Below, the cover-glass drawing attachment that is used in finding the power of WOULT microscope's lens

COVER GLASS

DROP

SLIDE



Left, one way of trans fering dust-garden spec-imens to a slide. The smear is dried, washed in alcohol and drained. A match is touched to the alcohol film remaining alcohol film while slide rests with specimen side uppermost



Illustration shows how to prepare a box to hold your color filters, so they're always handy for selection

material that composes one of the yellowish spots in your dust garden and mix it with a drop of water previously placed on a clean cover glass. Invert this cover glass over a slide that has a fairly thick ring of glass or other material cemented to it. The cover glass should rest on the ring, so that the drop of bacteria-laden water hangs down in the little well formed by the ring. You now can focus your lens on a thin layer of the water, where it adheres

to the cover glass. Another way of observing the bacteria is to stain and mount them. Clean a slide and cover glass with soap and water and dry with an old linen handkerchief. Then pass the glass pieces several times through an alcohol or gas flame to remove all traces of grease. Do not hold the cover glass in the flame long enough to warp it, Put a drop of water on the cover glass or the slide and stir in, with the needle, some of the hacteria mass. Do not add too large a speck of the organisms. Dry the specimen, using a (Continued on page 104)

STAR MOVEMENTS SHOWN IN TINY PLANETARIUM

INVENTED by a German school teacher, a miniature planetarium designed for use in high schools and colleges is said to reveal the movements of celestial objects as clearly as the large models, Stars and planets are shown as black spots against a white background on the interior of a hemispherical tent fif-

teen yards in diameter, by the apparatus.



SHIP HITS WHALE AS CAMERA SNAPS

RARELY does a collision between a ship and a whale occur but more rarely still is a photographer on hand to snap as striking a picture of such an accident as the remarkable view reproduced above. Passengers aboard the New York-bound liner President Taft thought the ship had hit a rock when the whale was struck, at a spot about 1,000 miles northwest of Balboa. The stunned whale remained afloat.

CALIFORNIAN RUNS HIS CAR WITH DIESEL OIL

A DUL carburetion and vacuum system enables George L. Moore, of Los Angeles, to drive his car using Diesel oil as fuel. Under the new system, the car is started with gasoline and run until it warms up. Then the Diesel categories of the control of





Above, how Diesel oil carburetor, installed in auto, works. At left is shown the gasoline and oil carburetors that are used in Diesel oil burning machine



Three-foot model of a steam tow boat demonstrates its power by pulling a twenty-six-foot boat with two persons in it. A quarter horsepower engine runs the miniature tug



GRASS CUTTER LOOKS LIKE A GOLF CLUB

RESEMBLING a golf club, a long-handled cutter for trimming grass and mowing down weeds has just been placed on the market. It is said to be more efficient than an ordinary sickle and saves kneeling down to cut the weeds.

THREE-FOOT TOW BOAT PULLS 26-FOOT PUNT

To DEMONSTRATE the power of a model of a Liverpool steam tow boat, its British builder attached the timy vessel to a twenty-six-foot punt. With two persons aboard, the punt was towed at the surprising speed of four miles an hour. The miniature tug is three feet long and is fitted with a steam engine that develops one-fourth horsepower.

Plane's Wings Support Thirteen Tons of Sand



tacular test the other day at a Burbank, Calif., factory. After a huge crane had turned the fuselage upside down, the wings were attached and loaded with sacks weighing thirteen tons, while additional

only five inches and returned to normal position as soon as the weights were removed, satisfactorily demonstrating their tremendous strength.

Big crane turned plane over for weight-carrying test

NICOTINE GIVES SMOKING ITS KICK

People enjoy smoking because of the nicotine in tobacco. This is a fact just announced by Yale University physiologists. Their tests show that the nicotine, when inhaled, stimulates the adrenal glands and that these in turn release a little of the sugar normally stored up in the body for muscle fuel, Photograph shows how nicotine absorbed by a smoker is measured by comparing drug in his breath with that found in the cigar.



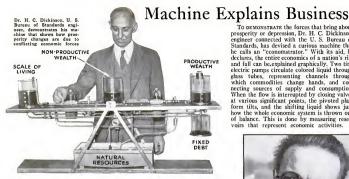
PENDULUM LEVEL MAKES ANGLE READINGS EASY

Readings impossible with levels of ordinary design are said to be given in-stantly by a pendulum level invented by a Californian, and illustrated above. Its gravity dial shows at once the angle or slope of machine parts, plumbing, roads, or airplane rigging. One side of the dial gives degrees, and the other the slope in inches per foot. Angles can be read with the level upside down.



Unlike most amateur craftsmen, Charley Grapewin, veteran stage actor who entered the movies two years ago, takes his hobby to work with him. To while away the waiting time between camera shots on the set, Grapewin found it possible to carry on his favorite pastime of making decorative inlays for furniture, with the aid of a kit containing thin strips of wood, a penknife, and a bottle of glue. Supplementing in this way the time he can spare for the workshop in his own garage, the actor has filled his home and office with unusual inlaid objects. Chairs, tables, a desk for his office, and numerous cigarette boxes are among the pieces he has decorated. One of his most remarkable feats of handiwork is a card table containing 365 inlaid pieces, created in only four days on the movie lot.

MAY, 1934 45



POCKET SCALE SHOWS PITCH OF ROOF



DESIGNED for architects, builders, and roofing contractors, a new pocket scale reveals at a glance the roof pitch of any structure and other information useful in estimating and construction. When the folding celluloid arms are aligned with the gable of a house or with a drawing or photograph of it, as at left, pointers on the scale indicate the angle in degrees and the rise in inches per foot run. A printed table shows the corresponding roof area, the required length of rafter, and the heel and plumb cut, which may be marked directly upon the rafter by using the scale as a protractor.

TINY GAS ENGINE MOVES FREIGHT CARS

WITH the aid of a tiny motor pusher developed in Germany, a single worker can roll a freight car to any desired spot on a siding, sparing the expense of operating a shunting locomotive. A six-horsepower gasoline motor runs the single drive wheel of this device, which rides along the rail on its rubber tire as illustrated below, pushing the car ahead of it. The pusher can also cross rails,



To DEMONSTRATE the forces that bring about prosperity or depression, Dr. H. C. Dickinson, engineer connected with the U. S. Bureau of Standards, has devised a curious machine that he calls an "economstrator." With its aid, he declares, the entire economics of a nation's rise and fall can be explained graphically. Two tiny electric numps circulate colored liquid through glass tubes, representing channels through which commodities change hands, and connecting sources of supply and consumption. When the flow is interrupted by closing valves at various significant points, the pivoted plat-form tilts, and the shifting liquid shows just how the whole economic system is thrown out of balance. This is done by measuring reservoirs that represent economic activities.



made. It is perfect in all details. Left, instrument made by Em-mons C. Moulton. Note the

SCALE-MODEL VIOLINS SMALLEST IN WORLD

Two skilled violin makers of Pasadena. Calif., participated recently in an unusual contest to see which could produce the smallest and most nearly perfect minia-ture instrument. One of the friendly rivals. Fassauer Ferron, labored for five months. His product was a tiny carved violin of seasoned wood, one and three fourths inches long, weighing less than one thirty-second of an ounce, and complete with ebony keyboard and miniature strings and pegs. The other, Emmons C. Moulton, took a month longer to complete a scale model one and a half inches long, with maple back and neck, spruce top, and ebony trimming, fashioning the strings of horsehair.

PESTS WASTE BILLIONS

THE annual board bill of American insects is two billion dollars. This figure, according to experts of the U. S. Department of Agriculture, represents the value of produce eaten or destroyed every twelve months by insect pests in American farms and orchards.

SECURELY pivoted to HOPE car gives thrill-seek of looping the lacroscope," a new of special instrument, no longer povitcase, can amplify faint sounds J0.000 times. According to the in-

.ntor, the sound made by tearing apart two postage stamps, if amplified in this ratio, could be heard more than 350,000 miles away. The instrument will detect the boring of worms in dock piling or reveal the sounds of human joints to aid medical diagnosis.



Noise microscope in use to amplify tick of watch. It can increase noise 100,000,000 times



In England clock dials are set beside the road

In circle, Hermann Grapow at work on his dictionary of Egyp-tian characters. Above, a page of data used in preparing the work. Right, some of the diction-ary's many handwritten volumes

WORLD'S STRANGE DICTIONARY HAS OVER 100 VOLUMES

WITH its hundredth volume just finished, in handwritten form, the world's strangest dictionary is still progressing to-ward completion. This monu-mental work will be the first

systematic dictionary of Egyptian hieroglyphics, and students of Egyptology have labored for more than forty years under the direction of Prof. Hermann Grapow. noted German expert, to prepare it. Its

CLOCKS WARN MOTORISTS TO TURN ON HEADLIGHTS

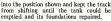
So that motorists will have no excuse for delaying, past the proper time, the lighting of their head lamps, special clockdial signs are being installed at intervals along country roads in England. The signs bear the legend, "Lighting-Up Time To-night," and the clock hands are adjusted daily to show at just what minute the legal period of grace after sundown ends. pages will permit a speedy translation of the ancient inscriptions found on tombs and pyramids. Indexing labels on the volumes present a curious appearance, since pictorial characters must be used.



FREIGHT CARS ANCHOR TILTING TANK

FREIGHT cars, serving as anchors for a large tallow storage tank, recently prevented a costly upset at an eastern plant, When the tank

was filled for the first time, it tilted sideways on imperfect foundations. To save it from toppling, workmen threw up timber braces set against a nearby railway track. Meanwhile two heavy freight cars were rushed





COLORED LIGHTS FLASH WHILE RADIO IS ON

To ADD to the enjoyment of a musical selection heard on the radio, a Brooklyn, N. Y., inventor has designed a loudspeaker attachment that flashes a succession of colored lights during the program. Four miniature colored bulbs are mounted inside the cone, and are lit in turn by a rotating switch driven by an electric clock.

Simple Stunts with Balls and Shadows Show

SUN

HOW THE Sun and Moon ARE **E**clipsed

In the illustration above, a lamp globe represents the sun, and a golf ball, the moon. A piece of curved cardboard is the earth's surface. The arrangement shows why the shadow cast by the moon upon the earth has a darker center called the umbra and is surrounded by a lighter ring called the penumbra. At right, diagram shows why all the sun's rays are cut off within the umbra during a total eclipse, and only part of them are intercepted within the penumbra

F IT were not for a strange coincidence, nobody on earth would ever have seen a total eclipse of the sun!

This famous and awesome phenomenon the blotting out of the entire sun in full daylight, is due solely to the accidental fact that the sun is 400 times broader than the moon, and about 400 times farther away. These facts make possible a total eclipse of the sun.

Because of the remarkable coincidence of size and distance, the sun and moon fill the same angle at the ob-

server's eye; or, in other words, they appear to be the same size to one on the earth.

The moon is roughly 2,000 miles in diameter; the sun is approximately 400 times as wide, or over 800,000 miles. The moon is about 240,000 miles from the earth. If the sun were exactly 400 times farther, it would be about 96,000,000 miles. As a matter of fact it is around 93 .-000,000 miles.

PENUMBRA

In a piece of cardboard representing the earth's surface holes A and B are made. Hole A is in the totally its constant to the surface of the surface of the card-tailty illuminated ring called penumbra. Looking through A the lamp is completely hidden by the golf ball as shown in the upper diagram at right. When you look through B a portion of the lamp can be sent of the surface abnow why toulity in a point extension.

is restricted to a narrow path, while partial darkn during an eclipse covers a much wider area on earth

Moon

What a surprising coincidence of distances and sizes, causing the sun and moon to occupy the same angle in the eye of an observer on earth! In a previous article we found that if a one-half-inch division on our

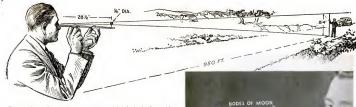
bow-rule was held fifty-seven times its length (twenty-eight and one-half inches) away from the eye, the one-half inch occupied an angle of one degree. (P. S. M., June, '33, p. 42). Accordingly, a one-fourth-inch division on the rule would represent the one-half-degree angle

occupied by the sun or moon. Here is a simple experiment you can

try which will give you a better idea than an ordinary diagram could of why the sun and moon occupy the same angle at the observer's eye.

Put a one-fourth-inch green pea on a toothpick, and insert the other end of the toothpick in a little hole near the end of a dowel rod. The rod is twenty-eight and one-half inches long. This will allow you to rest its end on your cheek bone while





The experiment above above why the sun, which is both 400 times wider and 400 times father away than the moon, appears to us to be the ensize as the moon. A quarter-inch pas is placed twenty-eight and a half inches from the eye. It then occupies one half a degree. A stick eight and the end of the degree. The length of the stick and its distance from the eye are 400 times the size and distance of the per, exactly as the sun is to the moon

By Gaylord Johnson

you look past the pea on the toothpick. The quarter-inch pea will then be 114 times its diameter away from the eye, and occupy an angle of half a degree at the eye, just as the moon does.

If you want to prove it, look at the moon with this piece of apparatus some night. You will find that the pea just eclipses the moon when you get them exactly in line with your eye.

Now for the rest of the experiment. If the quarter-inch pea on the stick represents the moon (2, 000 miles in diameter) and the town-veight and one-half inch dowel rod represents the distance from an observer on the earth to the moon, (240,000 miles) how the order to have ti occupy the same angle at your eye as the pea does? And how large will the sum be?

The answers are given when you multiply the peas distance (twenty-eight and one-half inches) by 400, and its diameter (one-fourth inch) also by 400. The sum will be 100 inches in diameter or cight feet four inches. The distance at which a stick eight feet four inches high is just covered by a quarter-inch pea (held twenty-eight and one-half inches from the eye) is 950 feet, or about two tenths of

The two illustrations at the right show why total cellipses of the sun are rare. The ring pane of glass, illustrates how the moon's orbit is at a small again, to the plane of the area of the sun are rare. The sun are rare to the ready and rotated slowly it be easy and rotated slowly in the earth and sun at only two only when the neon is at a mode that it can get in line with both he sun and the earth only when the moon is at a mode that it can get in line with both the sun and the earth the earth, as is seen in the upper illustration. At all other points, the moon casts as a sickenty seen in lower view as a is clearly seen in lower view in lower view in lower view in lower view as a sickenty seen in lower view in lower v





In the Illustration above, the reason for the greater frequency of partial eclipses of the sun is shown. This is due to the fact that there is a considerable zero an each side of a one of where a partial eclipse of the sun can occur. At any point within eighteen degrees of one of the moon's modes a partial eclipse is possible. When a new moon occurs at A, the sun is not obscured, but when the new moon gets between the earth and sun, as at B, a partial eclipse occurs. A new moon at C gives a total eclipse, but it is seldon the moon is new at this particular point

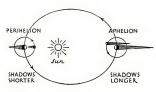
a mile. If you want to try the experience, get a friend to take the stick in a car, run off two tenths on the speedom-eter, and then hold the stick vertically on the road while you "eclipse" the stick with the pea which is resting on your eight-foot stick,

This experiment also enables you to visualize the proportions of the slender cone of shadow which the moon constantly casts into space. It is about in the proportion of one-quarter inch to twentyeight and one-half inches.

It is the narrow, pointed end of this shadow cone which travels across the earth's surface, and causes the path of totality during a total eclipse of the sun. The thickness of the shadow cone where the earth's surface cuts it is seldom over 100 miles, while at its moon end it is 2,000 miles in thickness, being cast, of course, by the moon's entire diameter.

This experiment has prepared us to understand the meaning of two terms which always occur in eclipse descriptions—the umbra and the penumbra. In plain English these mean "the shadow," and the "next to the shadow."

Both are demonstrated clearly in the experiment shown in the illustrations. The large electric bulb with the reflector represents the sun. The golf ball on a stick represents the moon. The circle where the shadow cone is cut by the surface of the card encloses the dark area of totality. the (Continued on page 112)



WHEN THE MOON'S SHADOW IS SHORTENED

The ellipse at the left represents the earth's orbit. The sun is shown slightly off the center. When the earth and shown, the moon's conical shadow is shortened by one sixtieth, but when they are farthest from the sun, as shown at right side of the ellipse, the moon's shadow is one sixtieth longer than at other titteth longer than at other times.

Test Handwriting as Indication of Character



With the aid of a new electrical pencil, the handwriting of a schoolboy is being analyzed to see if traits of character show in penmanship

Is your handwriting a reliable index of your character and temperament? With the aid of a new device, known as an electric pencil, perchologists are trying to settle this question scientifically in a laboratory at Budapest, Hungary, When a subject grasps the pencil and writes, a curve is simultaneously registered upon an automatic recorder. The speed of the writing is shown by the total length of the curve, and the height of each loop above a base line measures in grass the force used, while the number of impulses used in setting down a word is shown by the frequency with which the line is crossed. Thus the curve provides a precise analysis of the handwriting.

At left, specimen of analyzed handwriting. The wavy curves show the writing to be energetic. Height of loops above base line indicates the pressure used



CONTROL TOWER AT DAM RESEMBLES BATTLESHIP

Masts, turrets, and portholes may be discerned by an imaginative eye in the odd structure pictured above, which from a distance bears a striking resemblance to a battleship. Actually it serves as the main control tower for the great North Sea dam at Ymuden, Holland. The modernistic lines of the building contribute to the optical illusion it produces.

MACHINE SPREADS GAS TO KILL GRAPE PESTS

Lax hoppers that attack grape vines are being destroyed in California vineyards with the aid of an unusual machine resembling a pair of tents on wheels. As the tractor-driven machine crawls along between the rows, poisonous cyanide gas is blown into the tent-shaped chambers, which are open at front and back. Each plant gets an exposure of several seconds, which is sufficient to kill the insect pests. Perched on an elevated seat, the operator of the machine is not exposed to the deadly gas, which is sufficient to kill the control of the machine is not exposed to the deadly gas, which is heavier than air and clings to the ground.

MECHANICAL BRICKLAYER SPEEDS WORK OF MASON

ONE man can lay three times his usual quota of bricks in a day, it is reported, with the aid of a machine for the purpose that has been introduced in England. The mechanical bricklayer takes the place of a hand trovel, serving both as a container and an applicator for mortar. When a crank is turned, the device automatically advances, spreading a coat of mortar.

PLAN WEATHER REPORTS FOR TOURING AUTOISTS

STORM warnings for automobiles making cross-country trips form a possibility for the near future. Rex Martin, assistant director of aeronautics of the Department of Commerce, recently suggested to radio manufacturers that sets equipped to receive weather reports at frequencies of between 200 and 400 kilocycles would be according to the control of th



Turning the crank of this brick-laying machine advances it and spreads an even coat of mortar



Resembling two tents on wheels, this machine is drawn by a tractor between the rows of grape vines to spread poisonous cyanide gas. In this way destructive pests are easily exterminated



KNOCK-DOWN KENNEL EASILY ASSEMBLED



Any dog lover may build his pet a home, using only a screw driver and pliers for tools, with a knock-down kit recently introduced for the purpose. All-steel material is provided for the sides and roof of the kennel, which are insulated to keep the interior warm in winter and cool in

summer. The wood floor is removable for easy cleaning. Ventilation is provided for at the top of the kennel. At the front is a strong eyebolt for attaching the dog's rope or chain, while its name may be painted upon a nameplate over the doorway as seen in photo above.

USE LIGHT AND SUCTION TO TRAP TOBACCO PEST

SHAPED like the horn of an old-fash-ioned phonograph, an odd sucion trap has been developed by entomologists of the U. S. Department of Agriculture to aid in exterminating beetles that feed on cured tobacco in storage warehouses. The trap, they say, will catch millions of the cigarette beetles in a single season, attracting the insects by means of a low-power electric lamp bulb at the mouth of the horn. The beetles, lured this far, are caught in the power suction of a twelve-inch fan, and are drawn irresistibly through a screen-wire trap into a glass jar.

NEW BULLET FOR SMALL RIFLE CUTS CLEAN HOLE



SPOTING and scoring are made more nearly accurate by a 22-calibler cartridge recently introduced for indoor target shooting. The new cartridge, of a type hitherto available only in larger calibers, produces a clean hole that appears to have been cut from the target with a paper punch. The accompanying view shows the marked difference in design from the standard conclust type. Part of its length standard conclust type. For to fits length takes the riding is long enough to form a tight seal for the powder gas.



These big gratings on dam being built in Panama, will protect its powerful turbines from floating weeds

FLASH LIGHT FURNISHES FLOOD OR SPOTLIGHT

A FLASH light that gives either a concentrated beam or a flood of light is the invention of J. H. Kurlander, Westinghouse Lamp Company engineer. A tiny cylinder of translucent material is attached to a telescopic mechanism in the battery case, so that it can slide over the lamp bulb. When a button projecting from the case is pushed forward, the cyllenge of the control of the cylinder of the cyltological control of the cylinder of the cyllenge of the cylinder of the cylinder of the bulb and reflector, producing a thord of light. Moving the control button back permits the reflector to function.

GRILL WORK GUARDS

TO KEEP its turbines from being chode by tropical weeds, the great Madden Dam now rising at Alha-Madden Dam now rising at Alha-Madden Dam now rising at Alha-Madden Dam state of the state

HUNT WEED POLLEN MILE ABOVE EARTH

HUNTING weed pollen 5,000 feet in the air was part of recent experiments made by Dr. E. L. MacQuiddy, assistant professor of medicine, University of Nebraska College of Medicine. Bis study of the heights to which the floating pollen is carried during the hay fever season was conducted at altitudes that ranged from three to five thousand feet.



Pressing a button gives flood light or spotlight

WINGS TURN BICYCLE INTO A GLIDER With wings attached to this bicycle, the rider expects to use it as a soaring plane

SEEKING new thrills. a French bicyclist is experimenting with wings attached to the frame of his machine in the hope of soaring aloft. By gathering speed in a downhill

run, he expects to be able to life the cycle from the earth and maneuver it after the fashion of a motorless glider. The photograph shows the designer trying out his winged bicycle in an initial test.

TINY AQUARIUM AIDS MICROSCOPE WORK

WATCHING the behavior of tiny plants and animals is made easier for the amateur microscopist by a live cell recently placed on the market which serves as a miniature aquarium. With the aid of a medicine dropper, liquids containing living creatures may be placed in the cell for observation under the lens.





MANY CAN PLAY SAME PIANO AT ONCE

A MULTIPLE piano, just patented by R. W. Ross, of Mansfield, Pa., provides an innovation in piano instruction. When five or more pupils play on individual keyboards, as shown above, their notes are heard simultaneously upon a single elec-tric piano connected to the keyboards by

electric cables. By manipulating a control switch, however, the instructor can cut out all but one player at any time, in order to observe his individual performance and correct any faults. In this method, the students have the excitement of competition and the benefit of playing together.

ART WORK NOW MADE ON PORCELAIN

WHEN panels and shingles of porcelain when panels and simples of porceian enamel were used in the construction of the world's first "porcelain" house (P. S. M., November, '32, p. 44), H. Edward Winter, an artist of Cleveland, Ohio, saw the possibilities of the new material as an artistic medium. Working in the laboratory of the firm that built the house, he has recently developed richly colored murals of similar composition for interior decoration. After the enamel has been fused to its metal backing, the colors, applied through a stencil, are baked in, and the mural is then ready for hanging,





RED GLOW MARKS BURNT OUT FUSE

A FUSE that signals when it is burned out has just been placed on the market. This makes it unnecessary to grope about the fuse box

for the plug that requires replacing. After its fusible element melts,

a capsule of neon gas in the top emits a continuous red glow to attract attention. The detachable top may be used repeatedly, as the bottom half can be unscrewed and replaced with a special refill.

New Flying Boat Has Engine on Top of Wings

WINGS that arch diagonally upward from the fuselage give a new British flying boat the appearance of a sea gull about to alight on the water. Through this odd design, the engines, mounted atop the wings, are kept clear of spray in all but the worst weather. The big machine is a monoplane of sixty-foot wing spread. weighing more than eight tons when loaded, and propelled by twin engines. These power plants are provided with steam cooling system. From twin masts above the engines, wire strands lead out to serve as radio antennas.



Picture of England's new flying boat, with engines on top of wings, taken during its first tests

PLAN LIGHTS FOR ALL PARTS OF CAR





ELECTRICALLY POWERED CAMERA RUNS ITSELF

Mose complicated in appearance than the average movie machine, an electrically-powered still camera has been introduced in Hollywood, Calif, Permitting the camerman to give his entire attention to the subject, the camera automatically changes the film and registers the total number of pictures taken.

SPRING TRIGGER WORKS HYPODERMIC NEEDLE

INSERTED in a spring holder invented by a St. Paul, Minn., physician, a hypodermic needle gives a patient no uncomfortable prick



when drugs are to be administered. The spring, released by a trigger beneath the doctor's first finger, propels the point so rapidly through the skin that there is no time for the patient to experience a real sensation of pain.



Above lett, flecks of powder lodged in skin of finger when trigger is pulled. Above right, applying wax and chemicals so the powder can be seen.

At right, as the result of the chemical test, a blue ring appears as indicated by arrow



CHEMICALS TRAP MURDER SUSPECT

TELLTALE flecks of gunpowder, lodged in the skin, betray a shooting suspect through a modern method of scientific crime detection. To apply this delicate chemical test, a detective coats the trigger finger of a prisoner with warm mixture of wax, sulphuric acid, and diphenylamine crystals. If the suspect has recently fired a gun, a blue ring appears. caused by the reaction of the nitrate in the exploded powder with the chemicals.



REVEALED BY

Household





Epsom salts and milk of magnesia, two familiar household remedies, can be used to perform

ROM a box of Epsom salts, the home experimenter can learn a great deal about chemistry. This everyday substance supplies a convenient way of studying the mysteries of the metal magnesium and its many com-

Chemically, Epsom salts are known as magnesium sulphate and can be labeled as such when transferred from the bathroom medicine cabinet to the amateur's laboratory shelf. Physically, the salts are a crystal-like substance whose water of crystallization causes it slowly to turn into a fine powder when exposed to the air.

Being particularly soluble in water, magnesium sulphate lends itself well to an interesting experiment in solutions a demonstration of supersaturation. First, a strong solution of the chemical is made by dissolving it in boiling water. To free it of any impurities, the hot solution then should be filtered and allowed to cool undisturbed. At this point, the cooled solu-tion should be shaken. In most cases, the liquid immediately will change into an almost solid mass of crystals.

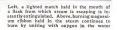
When shaking fails to start the crystallization, the solution can be seeded with a small crystal of the solid magnesium sulof the chemical will start the growth, forming thousands of tiny crystals that will increase in size until the entire container is filled.

Should the experiment fail to work the first time, add more Epsom salts to the solution and boil it again. The solution must be supersaturated before the mag-

nesium sulphate will start to crystalize. If a warmed solution of strong Epsom salts is poured on a sheet of clean glass. similar crystals of magnesium sulphate will be formed as the liquid evaporates. Spreading mysteriously over the surface, the fan-shaped crystals will resemble the decorative frosting often applied com-mercially to glass. In fact, many old-time formula and recipe books suggest that window panes can be given a frosted effect by applying a strong solution of Epsom salts dissolved in heer. Undouhtedly, the beer was included to make the magnesium sulphate crystals adhere more firmly to the smooth surface of the glass.

A second household chemical, milk of magnesia, likewise forms an inexpensive basis for many interesting experiments with magnesium. In the language of the chemist, milk of magnesia is a solution of magnesium hydroxide. Being a hase, it dissolves in weak acids to form mag-nesium salts. If added to hydrochloric acid, for instance, magnesium chloride is formed, while nitric acid combined with the chemical reacts to give magnesium

This solubility of milk of magnesia in acids and its nontoxic properties make it a useful antidote for the treatment of acid poisoning. The magnesium hydroxide neutralizes the acid on the skin or in the stomach and forms the corresponding



salt, which, in any case, is less injurious than the original acid.

In the home laboratory, you can pre-pare magnesium hydroxide simply by adding sodium hydroxide (lye water solution) to a solution of magnesium sulphate (Epsom salts). A white precipitate of magnesium hydroxide will be formed. To purify it, swirl the chemical around in water and then allow it to settle.

To test the remaining solution for the presence of the original chemical, add several drops of the sodium hydroxide solution to the clear liquid on top. If more precipitate forms, it is an indication that part of the original magnesium sulphate still remains. When this is the case, add more sodium hydroxide and again allow the precipitate to settle. This test-ing and adding should be repeated several

When no more of the magnesium sulphate is formed, the reaction is complete and the precipitate is ready for washing. To do this, carefully pour off the top liquid, which should be clear, add some fresh water, allow the precipitate to resettle, and again pour off the top liquid. After several washings, filter off the chemical. The magnesium hydroxide then can be dissolved in various acids to form

any number of other valuable chemicals.
As in many cases where a clear top liquid must be poured off to leave a precipitate, you may find that the movement of the container stirs up the chemical that has settled out. By using the simple Epsom Salts and Milk of Magnesia Furnish
Material for Spectacular Experiments in
Your Own Laboratory—How Brilliant Colors
Are Formed with Melted Magnesium Chloride



Illustration shows a siphon arrangement that can be used to draw off top liquid without disturbing the precipitate. Blowing in the short tube will force the liquid out the long tube

Using a peats and morrar, as above, magnesium ribbon and mercury can be forced to combine to form an amalgam of doors and ignite it by lighting a fuse

BLACK

PARTICLES

CARBON

SAND

of doors and ignite it by lighting a fuse made from a strip of magnesium ribbon. A brilliant flash will result, Because of the vividness of the flash, it is well not to look directly at the powder when it burns. Also, for safety, experiment with only a small quantity at

ERCO

a time.

When magnesium
burns in air, a white
powder results. This
residue is magnesi-

um oxide. Because of the oxygen that unites with it in burning, the magnesium oxide formed will be heavier than the original magnesium.

In our experiments with carbon dioside (P, S. M., Aug. '32, p. 60) we found that the gas ordinarily does not support combustion but is in a sense an excellent fire extinquisher. Strange as it may seem, however, magnesium will burn quite readily in an atmosphere of the gas. You can demonstrate this by lowering a burning strip of magnesium ribbon into a jar of carbon dioxide gas. The combustion will continue just as it did in the air, the magnesium burning at the expense of the combined oxygen in the carbon dioxide. The carbon set free from the carbon dioxide will be visible as black specks or flakes on the inside of the container.

A simple way to obtain the carbon dioxide for this experiment is to place several lumps of dry ice in a glass bottle as shown. To eliminate any chance of the bottle cracking from the heat of the magnesium, pour in enough sand to form a layer on the bottom.

Under certain conditions, magnesium will decompose (Continued on page 114)

By RAYMOND B. WAILES

siphoning arrangement shown in the drawing, however, this difficulty can be over-come. Simply allow the chemical to settle and then blow into the short rubber tube as indicated. This will force the clear wash liquid out through the long exit tube

without disturbing the precipitate. By mixing some of the magnesium hydroxide with strong magnesium chloride solution and kneading the mixture into a paste, you can make a useful white cement or putty. When allowed to dry, the mixture sets to form a smooth, stone-like material. Many types of flooring material material with the substance is used as a putty for filling crucks, fine swydust should be added.

With the aid of a gas burner, you can convert some of your prepared magnesium hydroxide into magnesium oxide, commonly known as magnesia. Place a small quantity of the magnesium hydroxide precipitate in a porcelain crucible or evaporating dish and beat it. After a time, your crucible will contain magnesium oxide instead of the original magnesium hydroxide.

The magnesia produced will be found to be particularly heat resistant and can be melted only under very high temperatures. Because it is a nonconductor of heat, this material has found wide use in the preparation of insulating materials for pipes. Chemically, it resembles ordinary lime

To prove that hydro-

chloric-acid gas is re-

leased when magnesium chloride is heated, a piece of blue litmus

paper, as above, is held

in the fumes. At right, illustration shows how to obtain carbon dioxide

from dry ice for mag-

nesium test. The sand

MAGNESIUM

RIBBON

LUMPS

OF

ICE

resembles ordinary lime (calcium oxide) since it combines with water to form a hydroxide.

Magnesium oxide also can be formed by burning the metal magnesium. Although this would be an expensive method of obtaining the chemical for laboratory use, it has the advantage of furnishing a spectacular experiment for the home chemist.

Magnesium metal is very light and almost white in color. It can be purchased
either as a powder or in a thin ribbon.
In the home laboratory, a small amount
will form the bast of many thrilling experiments.
When sprinkled on an open flame,

powdered magnesium burns with a vivid insh of white light and the illumination from a short length of magnesium ribbon will be equally intense. In fact, it is this quality of magnesium that makes it particularly valuable as a light source for indoor photography. Along this line, the home chemist can experiment with his own flashlight powders by mixing equal quantities of magnesium powder and powdered sodium chlorate. Place a small pinch of the mixture on a stone slab out

Household Inventions





REFUSE ROOM
IN WORK TABLE
Into the kitchen table
seen at left, receptacles
for refuse are built. Cans
and bottles go down chute
at right, while at left is
container for the garbage

RAZOR SHARPENER
Driven by a tiny electric
motor, this new razor
sharpener will strop and
hone both edges of a safety razor blade at the
same time. The device has
schromium-plated housing

JACKET KEEPS LIQ-UIDS HOT OR COLD Chilled beverages stay cold and hot ones hot when the bottle in which they are enclosed is covered with the thermal jacket shown at right. It is double walled and works on the principle of a vacuum bottle



SIGNALS MILKMAN
A bottle equipped with
tabs, that can be arranged in various patterns, signals the milkman the amount of milkdesired or the quantity
of other dairy products
needed. Device speeds
delivery and saves the



TWIN CLEANING PAILS

Cleansing solution goes in one side of the pail shown below, and clean water for rinsing in the other side. Thus it is unnecessary to climb down for clean water to finish the job



MAGNIFYING MIR-ROR. Provided with a non-glare light a new mirror is designed to help women secure a good makeup. A small section mag-

COFFEE MADE IN CUP. By making coffee in an individual cup, the time-saving device, at right, dispenses with the use of a percolator when







OPENER PUNCHES TWO HOLES A new-type can opener punches a big hole at the pouring edge of a can and a small air hole at the other edge so contents are instantly ready to pour



Set on a slant to each other, these two wheels revolve against the blade of a knife and quickly give it a lasting edge



CANDY MAKER'S THERMOMETER Attached to the edge of the receptacle in which candy is being made, a dial-faced thermometer is clearly in view so temperature can be read at any time



DOOR HAS KNOB IN WALL. Turning a knob built into one wall causea this sliding door to disappear into the opposite wall as shown

BEER COOLER. A thermos jug is converted into a beer cooler by putting on a spe-cially designed top that is equipped with an air pump, a beer intake, and a spigot. The top fits containers from a half gallon to three gallons



SIPHON FOR CARBONATED DRINKS. A pressure valve, housed within a metal cylinder that is pushed through the cap of a beverage bottle, acts as a siphon and releases the liquid under pressure The same of the sa



AUTOMATIC TEAPOT Requiring no attention after leaves have been placed in holder and hot water poured in, this teapot automatically brews tea. A timing cup meas-ures the minutes and basket bobs up when the tea is properly brewed





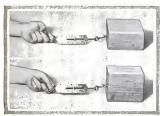
Home Tests of Scientific Laws



VIBRATIONS ARE THREADS OF TRANSMITTED EQUAL THROUGH HEAT DIMS A LIGHT. Connect a lamp with a bell-ringing transformer, as above, with a wire coil connected in series with it. Heating the coil dims light as heat raises resistance LENGTH RCD HAND SETS FIRST PENDULUM MINGING SECOND. PENDULUM STARTS SWINGING IN

RESONANCE

SYMPATHETIC VIBRATIONS The transmission of motion by vibration can be shown by tying two weights to threads of the same length and attaching them to a rod as above. If one is set swinging the other follows it



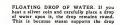
STRANGE LAW OF FRICTION. You can show that friction is independent of the area of the rubbing surface with the experiment pictured above. With a scale, the block is drawn first on its side and then on its edge. The reading is the same in each position

CARDBOARD

DRAWS NAILS
Cardboard squares, piled one on top of another, are placed in a wooden frame that is fastened with nails. If water is poured over the cardboard, the latter swells and the force exerted will pull the nails and force upward the top board



HOW STEEL GIRDERS BEND
A hack-saw blade is arranged as shown
at the right. It will bend if one small
weight is placed on it and it will bend
twice as much if two weights are put
on. This experiment proves girders
bend in proportion to force applied





MERCHANIC POST, DESCRIPTION AND MODERN PROPERTY AND A PROPERTY OF

HOT WATER LOWERS LIQUID IN THERMOMETER. Arrange your apparatus as above with water in the flask so it rises in the glass tube. If the pot of hot water is then raised around the flask, water in tube falls as glass expands

WIRE PUTS OUT

A coil of copper wire is inserted into a candle flame. Almost instantly the flame will go out. The explanation is simple. The wiring, in becoming hot, absorbs so much heat, the burning gases are cooled

Latest Kinks in Radio Field



to use earphones or loudspeaker by the flick of a switch. De-tail view of the adapter is shown in illustration at the right

Earphone Adapter Has Speaker Switch

O SAVE time and trouble in fitting a To SAVE time and troube in the same for broadcast receiver with earphones for long-distance reception, the radio fan can make use of the novel adapter and speaker cut-out switch shown in the illustration

The adapter is fitted to the prongs of the output tube and inserted into the regular socket, while the switch, equipped with convenient jacks for the earphone tips, can be placed on top of the radio cabinet or on any convenient table. The toggle switch can be manipulated to use either the loudspeaker or the earphones independently. When using the earphones, the screen-

grid circuit is used to protect the delicate coils from the high-plate current. At the same time, the speaker is cut out and the plate circuit is connected properly to avoid any harm from excessive voltages.

Thrown to the speaker side, the switch shorts the earphones out of the circuit and allows the receiver to operate in the usual way.

Auto Radio Serves In Summer Cottage

BECAUSE it operates entire-ly from a single six-volt storage battery, the modern automobile receiver forms an excellent unit for use in a summer cottage or vacation camp that is not wired for electricity. One reader of POPULAR SCI-ENCE MONTHLY, who has equipped his combination hunting lodge and summer cabin with such a unit connected to a regular full-size antenna, finds that he can save on battery switches the batteries, connecting the one that has been in his car to the power unit of the radio and placing the radio battery in the car. Because most of his summer driving is done during the day, one week in the car will recuperate a battery sufficiently to give a full seven days of radio service.-L. G. C.

Resistance Indicator Gives Accurate Data

So THE amateur radio craftsman can replace accurately and quickly, faulty resistance units in a receiver, a new type resistance indicator provides a simple method of measurement. Consisting of a large wire-wound resistance and a convenient movable-slider contact, this novel device is in reality a carefully calibrated variable resistance or potentiometer. To

charging bills by alternating between two batteries. At the end of every week, he

Suggestions to Improve Work of Craftsmen Who Build Their Own Sets

measure the value of some faulty unit in a circuit, the resistance in question is removed and two of the three wires extending from the indicator are connected to the free terminals. The slider then is adjusted back and forth until the tone and volume of the receiver is satisfactory or until a voltmeter placed across the resistor reads the correct voltage. When the desired conditions are obtained. the resistance in ohms can be read directly from the scale under the slider. To give a maximum range, two scales are provided making possible read-

ings from 100 to 100,000 ohms. The indicator also can be used as a calibrated potentiometer or adjustable-voltage divider.



Airplane Type Dials for Home Built Sets

LLUMINATED airplane style tuning dials of the type used on the newer receivers now are available for use on home-built sets. Arranged like the dial of a modern automobile speedometer, they give a full view of the entire scale range. To give the best tunning qualities, especially on the shorter waves, these dials are fitted with improved anti-backlash reduction gears, twelve complete revolutions of the knob being required to swing the pointer over the full scale. They can be installed easily on existing sets and thus modernize their appearance.



Resistance of faulty units in a receiver are measured with this indicator

Hunting Short Waves

REGULAR SET Often it is pos-sible to alter a broadcast superheterodyne so it will bring in po-lice calls by loosening the adjust-ment on the oscillator and radiofrequency padding condensers, as is shown at the left

By George H. Waltz, Ir.

LTHOUGH special receivers give the best results, they are not absolutely necessary to enjoy the thrills of the short waves. The experimenter, armed with a few simple kinks, many times can alter his regular broadcast set to bring in the adventures of the po-

lice, aviation, and amateur phone bands. One of the best ways to make use of a modern broadcast receiver on the shorter wave lengths is by means of an efficient short-wave converter. Such a unit, known as a superheterodyne converter because of its circuit, is illustrated on this page. As shown by the wiring diagram, the converter consists simply of a tuned circuit and oscillator complete with an A. C. power supply. In use, it is connected between the regular antenna and the antenna binding post of the receiver and serves to change or convert the shortwave signals that strike the antenna into such a form that they can be amplified by the regular broadcast circuit.

With such an addition, most of the short-wave bands can be covered. The tuning dial of the broadcast set merely is turned to some relatively quiet point and the condenser in the converter is used as a single control to tune in highfrequency signals. Since the use of a converter does not in any way alter the actual circuit of the broadcast set, but merely acts as an addition, it can be disconnected easily and the receiver will again bring in the broadcast band.

Another simpler, but not so reliable way, of obtaining a similar result with superheterodyne broadcast sets is to connect a special tuning circuit directly to the grid of the first detector tube in the circuit. As shown in the diagram, this method of snaring some of the short-wave thrills consists merely of substituting a short-wave tuning circuit for the one that already exists. For example, if the regular police and aviation bands, as well as a few of the local amateur phone stations, are to be covered, a regular 160-meter shortwave tuning coil used in connection with a variable condenser of the right capacity will serve. If desired, the unit can be permanently installed in the regular receiver cabinet and supplied with a simple change-over switch

that will make it possible to use the combination either for broadcast or short-wave reception. The receiver then in effect will become a dual-wave outfit. To cover the portion of the shorter

waves that borders the broadcast band.

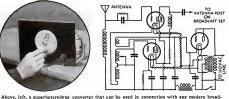
the two-winding coil should consist of a fifteen-turn primary and a fifty-three-turn secondary close-wound on a one- and onequarter-inch form. The primary of number twenty-six silk-covered wire should be spaced approximately one sixteenth of an inch from the number twenty-two silk-covered wire secondary. The variable condenser to match this coil should have a capacity of .00014 microfarads.

For best results with a minimum of broadcast pick-up, the tuning unit (coil and condenser) should be shielded and the connections to the receiver (grid and chassis) should be kept as short as possible. Experimentally, however, the cir-cuit can be used bread-board fashion at first and shielded later on if the interference prove troublesome and the shortwave results warrant making a permanent set up. An ordinary shielding can will serve as a combined cabinet and shield.

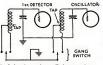
The method of tuning this combination depends on the intermediate frequency of the broadcast receiver. For instance, to tune a 2,000 kilocycle station, the receiver dial should be set at 912½ kilocycles if the intermediate frequency is 175 kilocycles or to 770 kilocycles if the intermediate frequency is 460 kilocycles.

Also, if the receiver used is equipped





Above, right, diagram of the converter



By fitting the receiver coils in a superheterodyne with properly placed taps it can be made to bring in messages from the short-wave stations. Above, diagram showing position of taps and wiring of switch



for automatic volume control the lower connection from the additional tuning circuit should be made to the corresponding end of the regular first detector input coil instead of to the chassis.

Many commercial broadcast receivers now being sold come already equipped for use on the police and aviation bands. On such a receiver, a flick of a switch serves to change the circuit over to bring in the shorter waves. In most cases, this switch, used in combination with taps, merely reduces the number of turns on various coils in the regular broadcast circuit.

Although it is a delicate job for the beginner, the experienced amateur should have little difficulty applying this same switching arrangement to his regular broadcast superheterodyne. It is necessary only to locate the coils, tap their secondaries at the proper point, and wire the leads from these taps to a convenient gang switch having as many independent pairs of terminals as there are coils,

As indicated, the taps should be made at the ground ends of the secondaries in each case, the number of turns being shorted out, depending on the increase in frequency that is desired. For instance, a change from the lowest regular broadcast frequency of 1,500 kilocycles to the police and aviation bands of approximately 2,000 kilocycles means a change of 500 kilocycles or an increase of one-third the original frequency. To alter the receiver coils

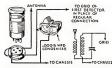


Diagram showing simple short-wave adapter circuit made from a plug-in coil and a condenser

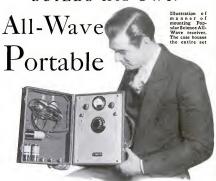
to correspond to this change, it will be necessary to place the tap at a point approximately one-third of the way up from the grounded end of the secondary.

The units that must be tapped in this way are the radio-frequency, oscillator, and first detector coils. Generally, these coils can be found easily by removing the various cylindrical shields that spot the upper face of the chassis. However, if there is any doubt as to their identity, obtain circuit and chassis diagrams of your particular receiver before going ahead with the work.

As with the simpler short wave tuning circuit already described, the actual wiring of the switch will differ slightly from the drawings if the broadcast receiver is of the automatic volume control type. In such a case, the switch arms should not be brought to a common ground. The contact arms of the switches for the radiofrequency and first-detector coil taps instead should be connected to the proper point in the automatic volume control circuit.

Because the leads from the taps to the switch may tend to upset the original circuit, it may be necessary to rebalance and retrack the receiver to make the dial read correctly on the broadcast band, Of

BUILDS HIS OWN



ESIRING light, portable, all-wave receivers for a summer camp and a cruising sailboat, Walter Bronson, a reader living in New York City, constructed the two units shown.

Although differing widely in appearance, both receivers were con-structed according

to the simple allwave circuit diagrams described in a recent issue (P. S. M., Aug. '33, p. 54). The smaller model is attractively and conveniently mounted in , " inexpensive imitation-leather hand case. As with the original receiver, the outfit is selfcontained; housing batteries, earphones. and plug-in coils as well as the six-foot antenna and six-foot counter-poise on

which it operates. The novel marine model, being wired for an additional amplifier and a loudspeaker as recently described (P. S. M., Nov. '33, p. 59) and supplied with a ninety-volt Bbattery source, is larger and heavier but ideal for use in a boat. For convenience in carrying, the builder has supplied the sturdy receiver frame with a convenient metal handle.

Incidentally, this all-wave circuit (15

to 1,500 meters) designed for POPULAR SCIENCE MONTHLY readers by an expert, has met with unusual popularity. Another reader, living in Asbury Park, N. J., reports that since constructing the set last January he has logged stations in England. Germany, Canada, Ecuador, Bolivia, and Brazil as well as

in the United States. In its original form, the two-tube portable receiver was constructed for less than fifteen dollars including the cost of tubes, batteries and earphones.



Here is the All-Wave circuit expanded for use in a sailboat. Note, batteries mounted under handle

course, when the switch is thrown to extend the frequency into the shorter waves. the dial readings will be meaningless.

Still another way of extending the range of a superheterodyne broadcast receiver temporarily to include the low frequency end of the short-wave band is to lift up all the way on the adjustment of the oscillator and radio-frequency padding condensers. Of course, before doing this, some

reference mark should be made on the screw and chassis or shield and count should be kept of the number of turns made so that the condenser can be reset without any great difficulty. Obviously, this method of bringing in the shorter waves on your broadcast set is at best a temporary makeshift. For best results, either the three-tube converter or simpler adapter should be used.

Saving Dollars

on your Car

HIS buggy sure is harder on the gas than the old one I had," complained the owner of a shiny, new sedan that had coasted to a stop beside one of the Model Garage gasoline pumps.
"What sort of mileage do you get?"

"What sort of mileage do you get?"
Gus Wilson inquired as he unlimbered
the hose and pushed the nozzle into the

filler opening.

In answer, the man pulled an envelope from his cost pocket and thrust it at Us. On the back was a hastily made tabulation of the gasoline used and the mileage. "About twelve miles to the gallon," the man grumbled. "After thirty years or more of making cars you'd think these automobile engineers could turn out automobile engineers could turn out the control of the

"They wouldn't do for you, Mr. Walton," the gray-haired mechanic inter-

rupted. "Ever ride in one?"
"No, but from what I hear they cer-

tainly are easy on the gas. Why, I'm told it's nothing for them to give thirty or forty miles to the gallon."

"Sure hand be yet a see in speed, power, and comfort," said Gus. "They don't use those light, economical cars from choice. They're a necessity. Gasoline is so expensive, they have to sacrifice every-thing for gas mileage. They don't mind small motors, light bodies, and a four-speed transmission that has to be shifted to the see that they have been considered the see that they have been considered they are the see that they are the see that they are they are

"IT's not fair to figure economy by the miles-per-gallon method. Too many things enter into it. Way back in 1904, they had a car that would do twenty miles on a gallon of gas, but I'll bet you wouldn't take it as a trade for the oldest hack on the road today."

"Well, if it's speed that's costing us money, why all the speed?" argued Walton. "Fifty miles an hour is fast enough for me. When I bought this car they told me it would do seventy. But when will I ever need that much speed? If you do



"This is my file of customers and repairs," Gus explained to Walton. As he spoke he began to finger the grease-smudged cards that the small, rectangular box was filled with

By MARTIN BUNN

over forty-five around here you get a ticket."

"Remember that old open touring car you had back in 1920?" asked Gus with a smile.

"A FINE car!" returned Walton proudly. "Bad all the speed I wanted. It went forty-five on the straight stretches." "Sure, and everyone in the car was gritting their teeth and planning which door they'd jump through if the old can left the road. I know, I had one," chuckled Gus. "And that's the answer to your question about speed. The cars of today are made to do sevently and eighty so they'll be able to travel forty-five safely without jarring your fillings loose. There's

and forty-five ten years ago.

"And another thing," added Gus. "Remember how you had to coax those old cars up to speed. Why, jumping from the up to thirty miles an hour is nothing today. And as far as economy goes, I'll beyou'll spend less on this car than you did on the old one."

some difference between forty-five today

"Maybe," agreed Walton. "But I'm going to do something about that gas mileage, too. When she gets broken in, I think I'll let you check up on that carburgetor."

"That'll help." nodded Gus. "And there are lots other things you can do to save money."

"What?" inquired Walton, interested.

"Well, in the first place, you want to give these tires of yours a little thought." Gus advised. "If you go easy on the speed and easier on your brakes, you can just about double the life of your shees. They'll be good for all of 20,000 if you're careful, but they won't last 10,000 if you ride them hard. Even figuring on a cheap set of tires, that means about twenty-five or thirty dollars.

or thirty dollars.
"It may sound silly, but engineers claim that even the roads you use have a lot to do with the cost of running your car. They've figured that if you can use concrete instead of macadam, you can save as much as two cents a mile on gas, oil, and wear.

"AND while we're on the subject, oil's another thing that can put a crimp in your gas mileage. If it's thicker that is should be, it adds just that much more to the work the motor has to do."

"Oh, I suppose those things mean something," agreed Walton. "But the real costs are gas, oil, and repairs."

"And you can cut down on the repairs too, if you're careful," answered Gus. "Wait a minute and I'll show you what I mean."

With that Gus disappeared through the door to the garage office. When he reappeared he was carrying a small rectangular box. "This is my file of customers and repairs," he explained as he approached Walton. "It's an illustrated story in itself".

As he spoke, he began fingering the greasesmudged cards, (Continued on page 115)

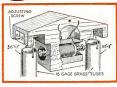


THE HOME WORKSHOP

MODEL MAKING: HOME WORKSHOP CHEMISTRY: THE SHIPSHAPE HOME

How to Make a Set of Musical





N MODERN homes, the

harsh sound of the doorbell or buzzer is a dis-

cordant note that is both

When the doorbell is pushed, a plunger strikes one of the chimes, and as the button is released, the plunger springs back and hits the opposite chime, thus sounding a double note

antiquated and unnecessary. It should give may to the soft, melodious, yet arresting tones of the
chime. Although expensive to buy,
suitable door chimes are easy to
construct and the equal of those
selling for many times their cost.

The body is cut from a block of

wood 3½ by 6 in, and approximately 2 in, thick. The finished thickness may vary a fraction of an incheither way from that shown in the drawing if the dimensions given in Fig. 2 of the working drawings are changed accordingly. To avoid splitting, select a piece of wood that is soft and of fairly close grain.

Cut the block to the shape shown in Fig. 1, and bore a 1-in. hole from end to end in the lower part to hold the coil. In the back of the block bore a recess 1½ in. In diameter and approximately ½ in. deep to provide space for the terminal screws and surplus connecting wire. The salightly into the hole provided for the coil, which will give sufficient space for the coil terminals to pass through.

At each end of the block, drill a 5/32in. hole in the center to a depth of 1/8 in. as shown in Fig. 1. This hole is for the adjusting screw, Fig. 4. which is made from a 2-in. No. 8 flathead wood screw. A circular slot, the inside diameter of which is 1/8 in., is cut in the screw as

KENDALL FORD

shown. The slot in the adjusting-screw retainer, Fig. 3, prevents the adjusting screw from moving out of place when adjustments are made. The screw retainer may be made of either tin or brass.

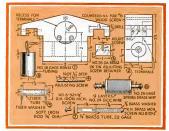
The adjusting screw and retainer are shown in place in Fig. 2, but the plate is not to be fastened permanently until the brass tube is suspended from the adjusting screw. The head may be removed from the adjusting screw and a slot cut in the end of the screw to give it a finished appearance, as shown in Fig. 4.



The form for the coil, Fig. 5, consists of a piece of fiber tubing ¼ in. in inside diameter, ½ in. in outside diameter, and 1¼ in. long, and two fiber washers 1 in. in diameter and ½ in. thick. The washers are drilled out to ¼ in. and forced over the ends of the fiber tubing.

Wind the form full with No. 24 double cotton-covered wire. If the winding is done carefully, there will be room for nine layers or 480 turns. The winding must not extend over the width of the fiber washers, otherwise it will be impossible to force the coil into the hole

force the coil into the hole (Continued on page 93)



Front and end views of the wooden block, and details of the coil, plunger, adjusting screw, retaining plate, and upper end of tubes



for Carrying

A junked front axle assembly in good condition forms the foundation for a boat trailer. The wheels must be lined up and locked in position

By William Jackson

WELL-BUILT boat trailer or an automobile boat rack will greatly active your enjoyment of boat and of water easily accessible, with corresponding interest in fresh sights and in the adventure of exploring new waterways. They enable you to enjoy a racing boat, sailboat, or motorboat even though you live at a distance from the water, and they afford complete freedom from damage to the boat or more. The last advantage alone makes the initial investment well worth while.

A trailer is more convenient than a rack attached to your car because it may be easily detached and parked, leaving the car free for sightseeing and unencumbered with luggage. Not only for boats but as luggage carriers, for camping, and for uses about the farm, home, and small business, these small trailers are timesavers and most economics.

The home-built trailer illustrated cost about \$15 to construct. The cost will depend of course, upon whatmaterial is purchased new and what is bought at the junk yard.

The type and dimensions of the trailer will depend upon your particular requirements. While a box body may be desirable for camping, a substantial oak frame will suffice for the sailboat or motorboat. Bolt themembers securely together and reënforce wherever necessary with strap iron.

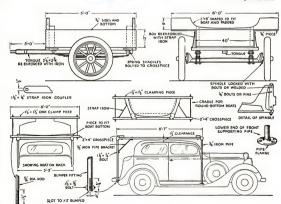
The front axle assembly may be purchased cheaply at the local junk yard or the used-car graveyard. The points to look for are: true-running wheels. good bearings. well-fitting axle assembly, and, if possible, wheels the same size as those on your auto. In the event of a puncture, the car "spare" will then suffice. Tires and lumber suffice. Tires and lumber

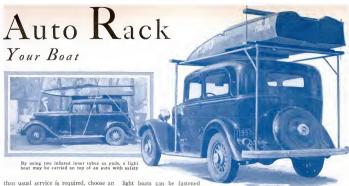
should be purchased new. Be sure to retain four spring shackles for each end of the springs. An old Ford model "T" front

axle assembly may be used for a trailer that is to carry light loads, but will have a tendency to rock. Where more



Another view of the trailer to show how the boat cradles are made. Below: Drawings of the trailer and also a boat rack for mounting on an auto





axle assembly with lengthwise semielliptical springs.

After hauling the axle assembly home, line up the wheels and securely lock them in one position. This is accomplished by clamping, welding, or securely pinning the kingbolt in the spindle housing. As kingbolts are ordinarily tempered so hard they cannot be drilled without difficulty, remove them and draw the temper. This is effected by heating the bolts to a red heat and allowing them to cool slowly. Reinsert the kingbolts, drawing the nuts up tight. After drilling 1/4-in, diameter holes through the spindle housing and kingbolt, insert 1/4-in. steel pins or bolts.

The frame or box for the boat or for luggage, as the case may be, is securely bolted to the spring shackles. For boats, a flat oak framework should be built, with shaped and well-padded pieces to fit the boat bottom. The length of the trailer tongue will depend upon the boat carried; that indicated on the drawings will be about right for most purposes, except where a longer boat than ordinary is to be carried. Make the tongue of heavy oak, bolting it securely to the underside of the trailer. If possible, reënforce the tongue with flat iron.

A sturdy coupling device is bolted to the trailer tongue and a corresponding unit attached to the car. The hitching arrangement will depend somewhat upon the load carried. For light loads a bumper attachment may be utilized, but for heavier loads the trailer tongue should be attached to the chassis of the car with a strong, heavy coupling device. A black-smith or garage will aid in making a strong coupling for your particular car, or you can buy something suitable from dealers in trailer parts or from one of the large mail order houses.

If a round-bottom boat is to be carried, a cradle and clamping device similar to that used upon the boat rack is utilized. A tail light or reflector should be carried on the rear of the trailer. A license is also required on trailers. If long trips are contemplated, some means of greasing the chassis should be provided.

Instead of being carried on a trailer,

on the roof of the car, as illustrated in the smaller photograph above. Obtain two large inner tubes and inflate them until they are without wrinkles. Place the tubes on top of the car, front and rear, near the center of the roof. Lift the hull upon the tubes so the weight is evenly distributed. Tie the front, rear, and sides down secure-ly. The boat will have little tendency to wabble and the car will ride easily.

A still better method is to construct a boat rack. With an investment of about five dollars, a rack may be con-structed like the one illus-trated. For a cheap, prac-

tical, demountable carrier, this is unexcelled, and it makes parking easy in congested places. Quantities of luggage, camping equipment, or an out-board motor may be carried inside the boat. The drawings give complete details.

The frame is constructed of 34-in. inside diameter iron pipe. New pipe with fittings will cost about five dollars, but if used or junk pipe is available, the cost may be reduced to two or three dollars. Although the dimensions given fit the 1933 Plymouth, these measurements can be easily adapted to any car.

As shown on the drawings, the top of the rack consists of two pieces of 3/4-in. pipe 8 ft. 7 in. long, and two lengths of 5 ft. 3 in. Each length is threaded at both ends, with one end of one of the lengthwise pipes threaded extra long-about 2 in. from the end.

The four lengths are joined together in the form of a rectangle with one 34-in. three-way pipe ell at each corner. That extra threaded length of pipe will enable you to get the last joint of the rectangle together. With the three sides of the rectangle completed, simply screw the extra length twice as far into the ell as ordinarily. The other end is now started into the opposite ell by unscrewing the pipe, so that the extra long threads, in

about five dollars. The in drawings at bottom of opposite page The four lengths of

pipe which form the top of the rack are joined by means of hree-way pipe ells. The two uprights at the rear are slotted to fit over bumper

unscrewing, enable the pipe to enter into the opposite ell and complete the frame. The uprights are cut to fit, allowing

the rack to rest level with about 11/2-in. clearance between the rack and the car roof. The two front uprights are threaded both ends. The two rear uprights are each threaded on one end, and the other ends are drilled and slotted deep enough to fit the bumper, permitting 34 in. of the pipe to project below the bumper. Drill 3/8-in. holes in the slotted end as shown.

Two 3/4-in, flanges are fastened to the

front uprights, and the uprights are screwed into the forward ells. The rear uprights are now threaded into the after ells, while the slotted bottom ends are slipped over the bumper and secured with two 11/2 by 3/8 in, machine bolts. Each flange is fastened to the running board with four 1½ by ¼ in, stove bolts. Two by 4's, each 6 ft. long, are butted against the ells and bolted front and rear through the pipe after the necessary 1/4-in. holes have been drilled, with one 3 by 1/4 in. machine bolt at each side.

If a V-bottom boat is to be carried, wooden crosspieces 11/2 in. thick are sawn to conform to the shape of the bottom at the front and rear, and are nailed to the 2 by 4 in, pieces as (Continued on page 98)

BO-PEEP HOLDS UP A CLOTHES RACK





This clothes rack, with its jig-sawed figure of little Bo-peep, encourages children to hang up their clothes

CHILDREN are much more likely to hang up their clothes neatly when they have such an attractive and convenient clothes rack as the one illustrated. Little Bo-peep and the baseboard are made of 1/2 or 5/8 in. thick plywood. Bo-peep is cut from a piece 15/2 by 31 in., and the base is 113/4 by 31 in. The clothes tree is merely a stick 1 by 11/4 by 36 in. with two wooden hooks screwed near the top.

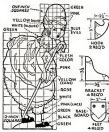
By marking 2-in. squares on a large piece of heavy wrapping paper and subdividing some of them into 1-in. squares as shown, you can make a fairly close re-production of Bo-peep. The squares of the head were made I in, to enable a more accurate drawing of the features. The full-size drawing can then be trans-

ferred to the plywood and jig-sawed. Sandpaper Bo-peep and the baseboard and give each a coat of shellac and two coats of white paint. The baseboard is then finished with green.

The clothes tree is held in place by four wooden brackets screwed to the baseboard at the end opposite Bo-peep.

It is painted a light brown. The features are traced on Bo-peep very lightly with a pencil on both sides. Paint the light colors first, leaving the facial features until last. A flesh color is made by mixing one part yellow with about one hundred parts white and toning with bright red. All colors, when dry, are outlined in black.

Bo-peep is held in place with quarterround molding screwed to the baseboard. The rack is a piece of broomstick screwed on the hat and clothes tree at the same height. In other words, the broomstick should be horizontal. Four feet are added as shown,-RAYMOND PETERSON.



DRIPLESS WATERING CAN



The slender spout of this homemade indoor watering can reaches within the foliage without spilling a

If you make a watering can as shown for indoor

use, you will get the water where it should be-on the plants. Its long slender neck will penetrate the densest foliage. The materials needed are a 1-lb. coffee can, 2 ft. of 3/8-in. copper tubing, and a tin roll or form of the type on which adhesive tape is sold.

The spout is 14 in. long, bent as shown, and soldered in a hole near the bottom of the can. A

1/16-in, wire is soldered to the spout and into a hole in the side of the can as a brace or support. The handle is made from the remaining 10 in. of tubing. For filling, a hole large enough for the adhesive tape roll to pass through is made in the lid of the can. The roll is then

placed in position and soldered. This finishes the edge of the hole nicely. The can shown was painted green. except the copper tubing, which was polished .- DANIEL REYNOLDS,



PLYWOOD TOP ENLARGES SMALL DINING TABLE

It is occasionally desirable to increase the size of a small dining room table by making a large false top. In this way a table that ordinarily allows room for only three or four persons may be temporarily enlarged for six or eight.

The false top illustrated was made in two pieces for convenience in handling and storing. Threeply veneer 3/8 in. thick was used. It is necessary to use thin wood in order not to increase the height of the table, yet the top must be rigid to prevent any springiness in the over-hanging part. Two semicircles were cut on a 27-in. radius, giving a top 41/2 ft. in diameter. This will seat six people comfortably. Then five cleats of the same wood were fastened to the back of each piece with 5%-in. No. 7 flathead brass screws. Each cleat overlaps the straight side of the semicircle by 3 in., as shown. The five cleats on one half of the top are placed so that their overlapping ends will lie snugly against the cleats on the other half and also alternately on the left and right sides of the latter cleats. When the two halves are pushed together, the cleats mesh closely.—Edward A. Hine.



With this extension top, a relatively small table may be used for a dinner party of six

PARAFFIN-SOAKED CORKS CAN BE BORED EASILY

ALL difficulty in boring holes in ordinary cork stoppers may be overcome by first boiling the corks in paraffin until they are saturated. Allow them to cool thoroughly, and then make the holes with an ordinary drill. Such corks are proof against acid and, of course, will not become water soaked.—R. R. A.



DIRECTORS AT WORK

A meeting of the Guild directors. Left to right are M. Allen Warren, counsel, Robert A. Horner, view president, LeVern T. Ryder, president, E. Raymond DeLong, secretary, and John Hendry, Carroll Carlson, Bert O. Schmaling, three of the directors

HOME WORKSHOP CLUBS

SHOW RAPID GAINS

OW well the National Homeworkshop Guild is progressing in its effective of the control of the co

POPULAR SCIENCE MONTHLY

If no club has been organized in your own locality, now is the time to get one started. You can do this without the slightest difficulty because the Guild has a complete, well-tested plan that tells how to find men who will be glad to join with you, how to hold an organization meeting, how to conduct the club meetings and all club activities, and how to plan instructive and entertaining programs.

The advantages of belonging to a home workshop club are obvious. It supplies the one thing that craftwork has heretofore lacked-companionship and cooperation with others. It gives you an opportunity to enjoy the good-fellowship of others who are interested in the same hobbies as yourself, to learn better methods of craftsmanship, and to work together on joint projects either for the club, the community, or individual use. It makes it possible for you to exhibit your handiwork where it will be genuinely appreciated and to receive the aid of the Guild in so large a variety of ways that it is almost impossible to list them all. The Guild and Popular Science Monthly, its official magazine, now form the great centralizing organization in the home workshop field.

Strictly noncommercial and organized without any thought of profit for itself or its officers, the Guild has no other purpose than to promote the use of leisure in all hobbies relating to the home workshop field. For full information, fill out the coupon at the end of this article.

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What Clubs Are Doing
. Novel Projects Made
by Members..Complete
Official News of the
NATIONAL
HOMEWORKSHOP
GUILD

By
E. RAYMOND DELONG
National Secretary

CHARTER
NATIONAL HOME WORKSHOP
WE GUILD, INC. W
Inc. 19 CERTY INA
GUILD, INC. WAR

What the charter issued to each club looks like—of course, on a greatly reduced scale

To each member of a local club, the Guild issues its official affiliate card. This is now the passport of the homeworkshop fraternity and entitles the holder to many benefits that will help him in his work and save him money. Be sure that you become a member of this organization, even if you have to start a club yourself, and make use of all the advantages and opportunities thus opened to you.

The competition among the clubs for new members is growing keener. The Amarillo Homeworkshop Club of Amarillo, Texas, had forged to the front and tied the Topeka Homeworkshop Club, of Topeka, Kans, with a membership of thirty-eight. The parent club in Rockford, Ill., of course, is larger. Other clubs that have shown excellent increases since the last report are the Denver Homeworkshop Club, Denver, Colo., the Cleveland Homeworkshop of Cleveland, Ohio, and the Billings Homeworkshop Club of Billings, Mont.

This trend toward increased membership is a very healthy and promising one. No home workshop club should be founded on the idea of a small, exclusive organization with limited membership. The more hobbies represented in a club, the easier it will be to devise entertaining programs and to coöperate in the hundred and one activities that make a club successful.

The Billings Homeworkshop Club, which meets in the homes of the various members, has developed a unique way of signalizing each meeting. An illuminated sign has (Continued on page 90)

MODERN-LOOKING BOOKRACK

A BOOKRACK is an attractive and useful addition to a desk or table, and by many is preferred to the usual book ends, which are more likely to slip and slide around. The one illustrated is a modern design, distinctive through the contrast of the woods used. By the selection and finish of the woods, it may be modified to harmonize with other furniture.

This rack is made of maple, with walnut strips inlaid in grooves on the ends and bottom, and finished in clear lacquer, rubbed and polished. The part of the walnut strips extending beneath the bottom serves as a support.

The maple is left in one piece while the grooves, 1/2 in, wide and 1/8 in, deep, are cut on a dado saw. If the saw is not available, a combination plane may be used.

The ends are next cut to length and squared; and notches are cut on the upper edges to receive the thick ends of the walnut strips, and on the lower edges to receive the walnut strips by which the rack is supported. Glue and flathead wood screws 134 in, long fasten the ends to the base. The screw heads are countersunk in the bottom of the grooves.

The strips on the ends, of selected walnut, are cut with a block at the top to fit the notches, thus eliminating a joint in the walnut strip at this point. The outer faces should be smoothly rounded, and filler applied before these strips are glued in place. The bottom strips, made thin-





edges.

The design may be varied



What distinguishes this bookrack are its bold, modernistic lines and the vivid con-trast of walnut strips against light maple

ner at the center to leave the support at

the ends, are next glued in place.

After the glue has set, the corners where the strips join are neatly rounded and the entire rack is sanded smooth, with the corners very slightly rounded.

Clear lacquer gives a hard, durable fin-It may be sprayed on or brushed, but if brushed, care must be taken to work rapidly to avoid unevenness. Several coats are necessary to give thickness enough to rub down to a smooth finish. If, after applying several coats, the surface is uneven, a sharp cabinet scraper will remove the high spots, saving much time in rubbing down. Rubbing with No. 7/0 or 8/0 waterproof garnet paper and water

If desired, the lacquer may be rubbed to a polished finish with rottenstone and water, A lacquer polish, as used for automobiles, is also satisfactory.

by the use of different woods, or by using the same ones in reverse order, depending upon the material at hand and the taste of the

OLD AUTO CRANK SERVES AS A FORMING ROLL

AN OLD automobile crank, or a rod shaped like one, if slit down the middle and inserted in the turned-up ends of a section of angle iron, makes a cheap and serviceable forming roll for light sheet metal, A square or triangular shaped rod may be used the same way by rounding the parts that pass through the bearings. The supporting angle is screwed to the edge of the workbench as shown in the photograph below.-- Joseph C. Coyle.



Forming cylinders of light sheet metal with a roll made by slotting and mounting a crank

BRICK EDGING IS AID IN TRIMMING LAWN

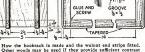
EDGING a lawn by the method illustrated below makes it possible to run one wheel of the lawn mower over the bricks. This climinates the tedious task of clipping the edge of the grass by hand. Another advantage is that the grass will not grow in between the bricks, as they are cemented together.

First dig or hoe out a trench about 1/2 in. deeper than the thickness of the bricks and about 8 in, wide. Use a spade to cut the sod along the lawn side of the trench so the bricks can be placed close to the grass. Mix 1 part cement to 5 parts of sand thoroughly before adding water. Then add enough water to form a medium mixture, A 100-lb, sack of cement will make enough mixture to lay about 80 ft. of bricks in this manner.

Place enough cement in the trench so that those bricks which are to be laid flat will be flush with your lawn. Put some cement between the edges of these bricks while laying them. After they are placed, start the angular row. This row is placed on edge at 45 deg. Cement these the same as the others. This will give a neat edge around your lawn, and the bricks will not get out of place.—J. P. KNIPP.



bricks so that no hand trimming is required



PISTONS MADE INTO MODEL WHEELS

You can make excellent disk-type wheels for model electric locomotives at trifling expense from old auto nistons.

The pistons are chucked by clamping on the skirt after shimming the slot, if of the split-skirt type. Turn the rim, leaving the tread straight. Next cut off with a gooseneck cutting-off tool or a hack saw, Reverse in the chuck. holding by the tread. and turn the back. Reverse again, holding by the flange, and turn the tread to an angle of about 5 deg., and also

finish-face the wheel. The hollow can be turned by rotating the compound rest, or if a sharper radius is desired, a tool point can be ground to the desired curve and



Wheels for model locomotive turned from pistons

the radius made by taking successive cuts. If great accuracy is desired, drill with a smaller drill and finish the hole with a boring tool,-FRED BAUER,





FINE-LOOKING

Hand-Wrought Hardware

MADE FROM CHEAP STEEL HINGES AND ORDINARY BAND IRON

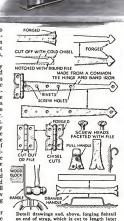
By Edward Thatcher

AFTER an excellent piece of furniture has been completed in the home workshop, it is often a problem to find suitable metal fittings for it. Common stock hinges and handles, useful as they are, may detract considerably from a carefully worked-out project, while hardware of suitable design and finish will add to its at every, is relatively expensive. It is therefore an advantage to know how to convert mild steel hinges of the most inexpensive variety and ordinary band iron into fine-looking hardware suitable not

only on furniture but on doors, closets, and cabinets.
Simple and beautiful designs may easily be worked out in keeping with the period in which the house is planned, such as Early American or Dutch Colonial. The larger sizes of stock hinges may be modified for use on heavy doors in the same way. The finished work closely resembles

The finished work closely resonance real forgings; indeed, you actually do cold forging of a very simple character. No forge is necessary for this work. Mild steel and band iron, which is really mild steel, can be worked cold because they will stand a lot of hammering before necessary, by heating it red hot and allowing it to cool in the air, but all the pieces illustrated were forged cold. The tools needed are generally found about the home shop—some sort of flat-faced avril, the heavier the better; a good bench vise; a machinist's hammer; small files, a hack saw, and a drill for drilling holes in mild steel.

Plain 3-in, butt hinges (or any other size) may be altered until they resemble





Screw heads are filed to give a handmade look. In circle: Chiseling a hinge barrel

those shown to the extreme right and left of the group at the top of the page, and many other simple designs in outline may be obtained in the same way on this type of hinge or on the other pieces in that illustration.

The two long strap hinges of the old fishtail and leaf or spearhead design shown in the center of the group were made from 3-in. T-hinges with a length of cold-forged band iron riveted to the strap. When (Continued on page 89)

Home Movies

HOW TO TAKE THEM LIKE A PROFESSIONAL

By Frederick D. Ryder. Jr.

HAPPENED to be in a photo dealer's shop the other day when a man came in to get his first roll of 16-millimeter movie film which he'd left for processing. So anxious was he to see the result that he asked the clerk to project it for him then and there.

Ninety times out of a hundred, a man's first movie film is used on shots of his home and family. This one was no exception. The first scene opened with a corner of his house. Then, with a breathtaking swoop, the house darted across the screen, paused for a moment, and shot up in the air as the camera was swung down for a close-up of a near-by bird bath.

The next shot showed an open expanse of lawn with a woman and a child standing motionless and grinning into the lens. There followed similar shots of another child and various relatives. The last scene was a quick flash of the family dog being held in position, much against its will, by a hand and arm sticking into the picture area from one side. All through the film, the picture gyrated about on the screen in a way that nearly tore your eyes out.





Best results are obtained with the aid of a tripod; wise use a three-point support as at the left

This film showed at their very worst the three faults most often found in amateur movie making. The first is too rapid swinging of the camera in taking a pan-orama. The second is fire-hose operation. By this I mean holding the camera loosely and moving it constantly so that the resulting scenes, when projected on the screen, bob around and hop all over the lot. Spraying the scene with pictures in this way is just a waste of good film.

The third trouble is lack of picture

planning and usually is due to a failure to grasp the essential difference between still photography and motion picture photography. A motion picture camera is designed to photograph objects in motion; you must, therefore, plan to get motion of some sort into every picture and do it in such a natural way that your subjects appear to be unaware that they are being filmed.

This applies, of course, to scenes that include people. In cases where the view itself is the object of interest, nature often supplies the needed movement in the shape of trees waving in the wind, waves breaking on the shore, and so on. Distant views can be planned to add life to the scene and also to let your picture show more territory.

A good rule in swinging the camera for

a panorama is to take at least twenty seconds for a ninety-degree swing or pro-portionately less for a shorter one. That should be the maximum speed. Even should be the maximum speed. Even slower is better if you can afford the extra film thus used. The same slow, steady motion should be used when you find it necessary to change the framing of the picture to follow the small movements of your subjects.

The best possible way to eliminate fire-hose operation is to use a good tripod fitted with a swinging and tilting head especially designed for motion picture work. Such an outfit is shown in one of the photographs. However, a tripod is a clumsy and cumbersome piece of ap-paratus to lug around on trips and hikes the times when you are sure to want to take pictures.

A tripod is steady because it has three points of support, and the best hand-held position for a motion picture camera also has three points of support. Another photograph shows how to hold it this way. The arms, steadied by pressing against the sides, form two of the points, and the cheek is the third.

If you want (Continued on page 85)

Portrait Photos

made by foolproof three-light system

WHEN your camera is loaded with fresh film and you can't quite figure out what pictures you want to take, why not see what you can do with three lights in taking a portrait?

Here is an example and also a diagram showing how the three lights were arranged when it was taken. The method requires one light to be placed rather close to the subject, directly to one side and a little above the head. The second light is placed on about a forty-five degree line, level

with the face and about twice as far away. The third light is BELOW HEAD LEVEL | placed behind, below, and slightly to one side of the head. You will find that this set-up will produce amazingly va-

LIGHT NO.2

ried results just by having the subject turn his head to different angles.



Portraits equal in quality to this are easy to take if three lights are used as shown in the small diagram

If you remove the third or back light, the arrangement becomes quite conventional. Removing light No. 2 will produce a queer, dramatic effect with a portion of the front of the face in rather heavy shadow. Be sure to shield your lens from the direct rays of light No. 3. Skillful lighting will give a professional quality to your portraits,

BIG THRILLS FROM LITTLE **NEGATIVES**

BRING out all the beauty of your snap-shots—enlarging does the trick. And now it's so easy-at home. With one of the new precision miniature cameras, you can get critically sharp negatives . . . with a simple darkroom outfit, you can do your own developing ... then with the Home Enlarger. you can make beautiful large pictures you'll be proud to frame and keep.

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KODAK HOME ENLARGER

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Taking pictures is only half the fun. Here, in one compact outfit, is everything you'll need for developing and printing. Includes safelight, trays, chemicals, graduate, stirring rod, developing clips, blotters, and Auto-Mask Printing Frame. In a durable, black fiber case, with instruction book-\$8.75.

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largements without showing graininess. Fully color-sensitive.

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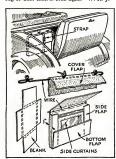
P. S. 5-34

Useful Short Cuts for MOTORISTS

Suggestions for Quick Repairs and Handy Improvements on Cars Made by Our Readers



IVING in a section of the country where fogs are a frequent danger to those who venture out in a car, I devised a simple kink to get clear visibility even on the soup-iest nights. Borrowing the idea from the modern neon beacon, I found that a smooth sheet of orange or light-red cel-lophane fastened over the lens of each head lamp with a strong rubber band colored the light just enough to allow it to pierce the fog. According to experts, the explanation is that light at the red end of the spectrum is less easily dispersed by fog or dust than is blue light.-W. R. J.



Side Curtain Case

TATHEN I first became the owner of a small roadster, I spent considerable time trying to find some convenient place to stow away the side curtains when they were not in use. At first, I decided on the tool compartment under the front seat, but the tools scratched the celluloid "windows." Finally, I made the simple case shown in the illustration.

A piece of heavy yet flexible cardboard

served as material for the case. It was cut cross-shaped, so that the flaps when folded back form an inch-thick envelope just wide enough and longenough to house the curtains. To mount the case, an

ordinary wire coat hanger was first straightened and then reshaped to form three small loops. These project through three small holes

cut in the upper edge of the case and hook over three hooks screwed into the wooden framework at the front of the rumble seat compartment. An ordinary slip-buckle strap is used to hold the case closed. If desired, the case can be

given a coat of shellac and then painted. When storing the curtains, all sides should be unfolded and the curtains laid flat in the case. Soft cardboard separators (shirt boards will serve) can be placed between the curtains to prevent them from rubbing together.-M. A. F.



Finding Faulty Plug

ALTHOUGH many tricks are used to locate a spark plug that is missing, the easiest way that the writer has found requires no tools or homemade testers, Simply start the motor when it is cold and allow it to run until it is warm. Then stop the motor and feel the base of each spark plug. The spark plug that has been miss-ing will be colder than the rest.—E. J. N.



Guards for Hood

ON MANY modern cars, the head lamps are so placed that they receive scratches and dents from the front corners of the hood everytime it is raised or lowered. This can be prevented by providing these offending front corners with improvised bumpers made by splitting short lengths of heavy rubber tubing lengthwise and slipping them over the bead that edges the corners of most hoods. If desired, the tubing can be held rigidly in place with cement .- O. B.

Mending Radiator Hose

WHEN making an emergency repair on a leaky radiator hose, your first thought will be to use ordinary friction tape. However, if tape is used alone, the heat and water soon dissolve the



adhesive. A better method is to use a long strip of rubber cut from an old inner tube. Wrap it around the hose in the manner shown. Then apply a layer of friction tape to hold it in place .- J. L.

Emergency Repair of Radiator Leaks



and poured in radiator. It coagulates and will stop a leak

ONE way to stop small leaks in a radiator of one egg to a froth, mix it with one quart of water, and pour it into the radiator. The writer has found that as soon as the water gets hot, the mixture coagulates and will stop any small leaks that may exist without interfering with the normal circulation of the radiator and cooling system.-K. M.

EVERY YEAR THOUSANDS ARE KILLED OR INJURED WHEN BLOW-OUTS THROW CARS OUT OF CONTROL









GET THE TIRE WITH THE GOLDEN PRY PROVED 3 TIMES SAFER FROM BLOW-OUTS

Get months of extra mileage, too...

ANYBODY that escapes injury from a wrecked car after having a blow-out is *lucky*. Because BANG! — when it does happen you might just as well be in a strait-jacket. You can't steer. You can't stop. You're headed for trouble.

Today's high speeds-40, 50 and 60-Today's high speeds—40, 50 and 60— generate terrific heat inside your tire. Rub-ber and fabric separate. A blister forms... inside the tire, where you can't see it... and GROW'S, until... BANG! A blow-out!

To protect you from blow-outs, every new Goodrich Safety Silvertown Tire has the Life-Saver Golden Ply.

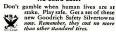
This remarkable invention resists heat. Rubber and fabric don't separate. Thus blisters don't form inside the tire. The great, unseen cause of blow-outs is thus prevented by the Life-Saver Golden Ply. And here's proof.

Racing daredevils tested the Golden Ply at breakneck speeds. On the world's fastest track. Gave it everything they had. Rubber got so hot it fairly smoked. Not one blow-

out. Similar tires without the Life-Saver Golden Ply failed at one-third the distance the Golden Ply Silvertowns were run.

For everyday driving, think of how much safer you and your family will be with a set of Golden Ply Silvertowns on your car! And without the destructive effects of internal friction to weaken it, think of the months of extra mileage this big, rugged Silvertown will give you.

No extra cost!



FREE! Handsome emblem with red crystal reflector to protect you if your tail light goes out. Go to your Goodrich dealer, join Silvertown Safety League, and receive one FREE. Or send 10s (to cover packing and mailing) to Dept. 339, The B. F. Goodrich Rubber Co., Akron, O.









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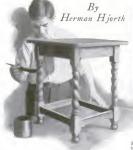
Easy to Use
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YOU CAN LEARN TO DO

Spiral Turning

by making this stand or coffee table





Two opposite sides are glued, clamped, and held together with hand screws to prevent twisting

Staining the completed stand. By increasing the dimensions slightly, it can be used as a coffee table

PIRAL legs on tables, chairs, cabinets, and other pieces of furniture are an effective form of decoration. Any woodworker can make them without previous practice at the very first attempt.

previous practice at the very first attempt.

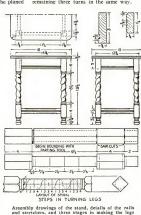
The legs of the stand shown in the accompanying drawing, like most spiral legs, have square parts. They must therefore be planed

square before they are turned. Begin by planing two adjoining surfaces on each leg straight and square to each other. Then set marking gage to 13% in. and gage this distance from the squared sides on each leg. Plane the remaining two sides to the gage lines and saw the legs to length.

Place the legs side by side, lay out the square parts, and square lines around each leg at these points. Center each leg carefully in the lathe. Before beginning to turn, it is advisable to make a saw cut in each corner just outside the lines marking the square parts. Begin the rounding process by making one or two cuts with a parting tool at the saw cuts as shown in the first of the detail drawings. Finish the rounding with gouge and chisel as in the second detail drawing. The square corners are easily rounded with a 1/2-in. skew chisel, which is held flat on the tool rest as in the scraping method

The spiral itself must be made by hand as it cannot be turned except on a special production lathe. It is laid out as follows: Divide the straight cylindrical piece into equal parts; in this case four is about the right number. Subdivide each of these parts into four equal parts and mark lines around the cylinder as shown in the third detail drawing. The

cylinder is now also divided lengthwise into four equal parts. The division lines may be marked from the square edges of the legs. Begin drawing the spiral at line a, continues to where lines b and t intersect, then proceed to where lines b and a, next to line d (opposite to b) and 3, and then to lines a and 4. Complete the remaining three turns in the same way.





After the spirals have been cut with a back the rough shaping is done with a chisel

Saw along the spiral line with a back saw to a depth of about 1/2 in.; then make V-cuts to the bottom of the saw cut with a chisel. Finish the bottom of the cut with a round file, and smooth the sides with a flat file and sandpaper. Do not finish the spiral too abruptly at the ends, but gradually taper it off as shown on the drawing of the stand. Note that the spiral runs in opposite directions on each pair of legs. During the carving, the leg may be supported on the lathe centers.

The rails and stretchers are now made. If so desired, they may be made a little larger than the dimensions given, so that the stand can be used as a coffee table. The lower edges of the rails may also be shaped instead of being planed straight. The beads shown on rails and stretchers are cut with a homemade tool called a scratch stock, previously described (P.S.M., Dec. '33, p. 80). The stopped chamfers on the stretchers are made with a chisel and a block plane or with a scratch stock.

The rails and stretchers may be joined to the legs either with dowels or with mortise

and tenon joints. Glue two opposite sides first. Place the clamps on the face side, and hand-screw the two glued sides together as shown in one of the photographs to prevent the clamps from twisting the legs out of square. When the glue is dry, the sides are joined with the remaining

two rails and stretchers. The top should be made from two or three narrower boards rather than from one wide one. It is preferable to start planing a gluedup top across the grain. Use a very sharp plane and take only light cuts. Smooth with a cabinet scraper along the grain, and finish with sandpaper.

The stand may be stained and finished with three or four coats of very thin shellac. Rub between coats with No. 2/0 or 3/0 steel wool. Apply a coat of wax over the last coat of shellac and let it dry over night. Polish by rubbing briskly with a soft cloth.

List of Materials

	No. of Pieces	Description	т.	W.	L.
١	4	Legs	15%	1 5%	191/2
	2	Rails	34	3	13
	2	Rails	34	3	11
	2	Stretchers	3/4	11/2	13
	2	Stretchers	3/4	11/2	11
	1	Top	34	15	18
	NOTE:	Dimensions	are given in	inches.	These



WHEN a friend of mine lent me my first pipeful of Union Leader, I had no idea it cost but 10¢ a tin. If I had known that ... maybe I'd have been chary of it . . . for I'm pretty hard-boiled and fussy about tobacco.

That first pipeful won me . . .

and my pipe. We both fall pretty hard for good old Kentucky Burley . . . and I never tasted smoother Burley than Union Leader. I smoke it regularly, not alone because it's a big value, but because it's a grand smoke. (Good for cigarettes, too.)

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Each story must be a true experience of the writer or some one he knows. Literary ability not necessary, as stories are judged for interest only. Last date to mail letters this month, May 31.

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ı	Dealer's Name
1	Dealer's Address
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Quaint Bird House



Front view of the bird house. The rea only a single window and window box. Rig Marking position of the screws on a roof be

By Morton Bartlett

HIS brilliant, gnomelike bird house will add color to any garden. What is more, it will attract a family of birds and be lived in by them in spite of— or possibly because of—its scarlet roof, its window boxes, and its painted flowers.

The main structure of the bouse is of 1/2-in. white pine. The front and back ends are first

jig-sawed out. They are 8 and 63/4 in, high respec-8 and 634 in, night respec-tively, and 634 in. across the bottom. At the widest point, where they flare out, the ends are 7 in. The recessed Dutch door

panel is made by placing the hole for the door on a piece of 1/4-in, wood and tracing the outline. The the same way on 1/4-in. wood which has had grooves cut across the grain with a sharp chisel to sim-ulate blinds. These parts are cut a little larger and trimmed down so they will fit very snugly. They are forced into place, flush with the inside, to give



The ends are screwed to a 6½ by 7 in. base-board. The sides, 1¾ by 7 in., are next nailed in place with 1¼-in. wire brads. The convex side is shaped with a plane, and the concave with a gouge. Finish with coarse sandpaper. The front end is beveled around the top to match the slope of the roof toward the rear. The window boxes are pieces of 1/2in, wood iig-sawed out a little crooked and tacked in place under the windows. The curved roof is made

a recessed effect from the outside as shown,

from 1/4 in. white pine, prefcrably green. Two pieces 11 by 12 in. will be needed, and it would be well to have a couple of extra pieces in case any split beyond redemption.

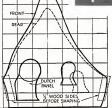
Lay one piece for the chimney side of the roof on the bench top, and place the house on it in the approximately correct posi-tion. Draw pencil lines guided by the outside of the two ends, as shown in one of the photographs, and indicate the centers of the concave places both on the house and on the roof board. Also mark one of two other strategic places for screws. Removing the house, drill holes 1/4 in. inside the lines where marked. The holes should be not quite as large as the shank of a 1½-in. No. 9 (3/16-

in.) wood screw. Drill holes into the ends of the house with a No. 52 drill

to receive the screws. Screws are put through the holes in roof as far as they will go and started in the house, but without exerting dangerous pressure. With one side of the roof on, let steam from a boiling kettle blow on it; or the boiling water itself may be poured on. Tighten the screws bit by bit, working first one then another. Too much speed will result in splitting the roof. The screws may be helped by pressing

on the roof with gloved hands as they are tightened The chimney, carved from wood 7/8 by 2 in., is screwed from underneath before putting on the other side of the roof. Fitting the roof at the peak when both sides have been steamed in place is a matter of whittling and joining

in which the worker must use his individual



How to lay out the front and back. Above: The lantern must be soldered so it will not swing

skill. The final step is to cut the outline of the roof with the fret-saw blade at a 90-deg. angle to the handle. The house is then put in a warm place for two or three days to dry out thoroughly. After this, cracks and screw holes may be concealed and the angles at the overhanging peak and the base of the chimney rounded out with wood substitute, and the whole finished with fine sandapaer.

Painting is done with outside colors. The roof is red; the house, white; door, yellow; blinds, green; window boxes, gray; chimmey, red with a white or terra cotta pot. The flowers may be painted with artists' colors and renewed each year. A little

black may be used sparingly around sashes and to

represent binges.
The lantern, which is added last, consists of square radio bus wire and two cones of thin copper. It is secured to the house with small staples. The wire is painted black, and the lantern decorated as you like.

The house should be erected on a pole 8 to 10 ft. above the ground in a place where people do not pass too frequently. The fresh smell of paint may keep the birds away for awhile, but in the end they will come to it. I have had both bluebirds and swallows in bouses of this construction.



Cut the chimney to this pattern from a 7/8 by 2

Dimensions may be modified to suit the particular birds you wish to attract. For a labulation of suitable sizes, see P.S.M., Apr. 34, p. 93.

SIMPLE DRILLING JIG FOR MODEL DEADEYES



DEADEVES for ship models or any other small cound objects can be held securely for drilling in a clamp made as shown in the drawings above. The deadeye is placed between the two wooden jaws, the tapered ends served to a board or to the bench top. A light tap on the rounded ends of the jaws will make them grip the deadeye as tightly as necessary to prove the deadeye as tightly as necessary to prove the deadeye. A Synakoves.



Dirty or Worn SPARK PLUGS waste 1 GALLON of GAS in 10

STOP THIS LOSS by having OXIDE COATING
CLEANED from ALL YOUR PLUGS

It is unnecessary to let dirty or worn spark plugs waste gasoline—and rob you of new-car performance—when spark plug cleaning by the new AC method is so quick and thorough. Most motorists don't realize that their engines are missing intermittently—in acceleration, at high speed, or going uphill. Blame dirty or worn spark plugs for that—also for eating up one gallon of gas in every ten. Badly worn electrodes, or oxide coating, forming on the insulator of every plug, cause this waste and loss.

HAVE YOUR SPARK PLUGS CLEANED NOW

and the spark gap adjusted, in a few minutes, and at low cost, by any AC spark plug cleaning station. Motorists who have their plugs attended to two or three times a year stop waste, save far more than cleaning costs and enjoy new-ear performance.

NEW AC METHOD CLEANS SPARK PLUGS LIKE NEW

After Cleaning

New AC cleaning method removes all oxide coating, soot

and carbon. Insulator is

Nearly every garage and service station is now equipped with the new AC cleaner which removes all oxide coating, soot or carbon in quick time. The AC method cleans all plugs like new—and no plug can escape oxide coating. Go today and have your plugs cleaned—stop waste of gasoline and loss of power—regain good performance and satisfaction. Have badly worn plugs replaced.



Before Cleaning
After a few thousand miles,
oxide film, soot or carbon
coats spark plug insulators,
wasting gas, impairing per
formance. This plug is worn,
its spark gap too wide.
This is an unretouched photo.

wasting gas, limpairing performance. This plug is worn, its apark gap too wide. This is an unretouched photo.

AC SPARK PLUG COMPANY

Flint, Michigan

St. Catharines, Ontario

FREE EVERY WEEK, NEW FORD CHEVROLET OR PLYMOUTH

While having your spark plugs cleaned, get an official entry blank and try for the Plymouth, Chevrolet or Ford which AC is giving away each week. Laugh at Raymond Knight and the Guekoos in the AC Spark Plug Derby—NBC Network. See newspaper for local station.







CUTLERY!

Who called it cutlery?

UTLERY means knives and shears that cut. The dictionary has no word for dull ones which only chew and tear. Look up words like chop, gash, hack, hew, sunder and chew. They describe the cutlery in the average home

A Norton Pike stone, or household grinder will put the cut back into your cutlery. The butcher uses them to sharpen his knives and cleavers. The woodsman uses them for his axe. Carpenters, cabinet makers and master machinists use Norton Pike Oilstones to put hard, supersharp edges on fine steel tools. Expert workmen know when to use an India Oilstone or that aristocrat of all stones, the Hard Arkansas.

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How to sharpen different tools according to their shape and purpose is told and pictured in the Norton Pike free book. What a man doesn't know is often hard to imagine. Why guess about this book, Write today before you forget.



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BLUEPRINTS



FLYING MODEL

IF YOU would like to try your hand at building a flying airplane model with a 4-ft. wing spread, get our Blueprints Nos. 141-142-143 for the famous Winnie It is far superior from an aeroic standpoint to most models. detailed instructions, 75 cents.

O AID you in your home workshop, POPULAR SCIENCE MONTHLY offers blueprints with working drawings of a number of well-tested projects. The hlue-prints are 15 hy 22 in. and are sold for 25 cents a single sheet (except in a few special cases).

Order hy number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more hlueprints in the complete set. If the letter "R" follows a number, it indicates that the hlueprint or set of blue prints is accompanied by photographically il-lustrated instructions which supplement the drawings. If you do not wish this supple-ment, omit the letter "R" from your order and deduct 25 cents from the price given. The instructions alone are sold for 25 cents each.

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Bookshelf and Book Ends, Modernistic, 100	
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Lamps, Modernistic, 93	
Mirror, Scroll Frame, 105	
Pier Cabinet and Corner Shelves, 77	
Screens, Modernistic Folding, 91	

Insure Your Success

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sewing Cabinets, Two, 31. helves and Lamp, Modernistic, 93	.25 .25 .25 .25 .25 .25 .25 .25
RADIO SETS	

All-Wave Portable Receiver (battery),
2017 Portable Receiver (battery),
2017 Portable Receiver, 155.

Amateur Radio Transmitter, 189-184.
Amplifier, Three-Stage, Audio-Frequency, 42
Five-Tube Short Wave Set (A.C. or D.C.).
Full Electric Headphone Set, 100.
One Tube (battery operated), 101.
Screen-Grid Set, 109.

SHIP AND COACH MODELS Construction kits are available for some of these models. See page 6

Some of these models. See page 6 j. Bark, Seenic Half-Model (135;1-m.), 108... Battleship—U. S. & Texas (8-ft. hull). Settleship—U. S. & Settleship—U. S. & Settleship—U. Settleship—U. S. & Presson (314;-in. hull). 151... Bettroper—U. S. & Presson (314;-in. hull). 151... Settleship—U. S. & Presson (314;-in. hull).

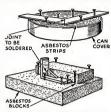
MISCELLANEOUS

Bird-House Patterns (full size), P-1-2-1.
Doll's House, Colonial, 72.
Log Cabin (futer erooms), IJs-R.
Log Cabin (futer erooms), IJs-R.
Perpetual Star Chart, IJsTool Cabinet, Bench Hook, etc., 30.
Toy Airplane Cockpit with Controls, IJsToy Birds and Animals, Ig-Sawed, 56.
Toy Dirds and Animals, Ig-Sawed, 56.
Toy Dirds and Animals, Ig-Sawed, 56.
Toy Dump Truck, Fire Engine etc., 301.
Workbench, 18. .25 .25 .50

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SOLDERING PADS MADE OF SHEET ASBESTOS

FOR those who use a jeweler's lamp and blowpipe in soldering small articles, these asbestos pads will prove helpful. The first one is a circular pad made from asbestos strips, wound tightly and pressed into a can cover. The pad should be thick enough so that the ordinary pins used in bolding the

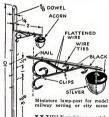


The first pad is a coil of asbestos strips; the second is made of sheets pasted together

work may be inserted their entire length. If the strips are not cut evenly, the pad may be sandpapered down to produce a level surface flush with the edge of the cover.

The second type of pad consists of two rectangular blocks built up of sheets of asbestos, which are held together with common flourand-water paste. Other forms may be made for special soldering jobs, but the pads shown, when used in combination, will take care of all ordinary jobs.—I. W. CLEMENT.

ACORNS SERVE AS LAMPS IN MODEL OF A CITY



WHILE making a model of part of a city, I solved the problem of providing suitable lights to hang from the sty using acorns. The acorn of

lamp-pool able lights to hang from the lamp-pool able lights to hang from the hang from the red oak justing atoms. The acorn of the red oak left is a ½- or ¾-in. dowel loin. long. The bracket is a ½-/ or ¾-in. dowel loin. long. The bracket is a ½-/- in. mail and two pieces of heavy wire that have been two properties of heavy wire that have been to the desired shape and fastened together with small clips made of wire. The acorn is fastened to the bracket by a wire running is fastened to the bracket by a wire running the state of the foot rests are small through the wire with the cold and set in at 1-in. intervals.

The bracket and the cup of the acorn are painted black, and the lower part of the acorn is painted silver.—J. A. MAROTTA.

101

MONEY SAVING HINTS FOR THE MAN WHO HAS HIS OWN WORKSHOP



"Yes, it's a beautiful piece of wood and I don't want to spoil it. How do you think it should be finished?" • "I don't know. But I have a new book at home that will give you some ideas. I'll run over and get it—be back in just a minute."

"Exactly what I wanted. And here's something else-a way to get a natural wood effect over old paint. Where did you get this book?" • "Down at the store where they sell Lowe Brothers paints, They're giving it away ... free."

Can lacquer be applied over painted, varnished or enameled surfaces? When both stain and filler are used on new, open grained woods, which should be used first?

These questions and many others are fully answered in our new book—"101 Questions About Painting and Decorating." It also tells you how to select attractive color schemes for your

color schemes for your home and how to paint various surfaces—exterior and interior. Get a free copy from your local dealer in Lowe Brothers products. It will save you time, trouble and money.

And, remember this—analysis shows so-called "cheap" paints to contain as much as 63% water and other evaporating liquids. In contrast, Lowe Brothers paints contain 90% film-forming solids consequently they cover more surface, last longer and cost

> much less in the end. The Lowe Brothers Company, Dayton, Ohio.

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This helpful book now offered free by dealers in Lowe Brothers products.



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UNRULY HAIR

Stays Neatly Combed

Costs but a few cents to use

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IS YOUR HAIR difficult to keep in place? Does it lack natural gloss and

lustre?

It is very easy to give your hair that rich, glossy and orderly appearance so

essential to well-groomed boys.

Just rub a little Glostora through your hair once or twice a week — or after shampooing, and your hair will then

stay, each day, just as you comb it. Glostora softens the hair and makes it pliable. Then, even stubborn hair will

stay in place of its own accord.

It gives your hair that natural, rich, well-groomed effect, instead of leaving it stiff and artificial looking as waxy pastes and creams do.

Glostora also keeps the scalp soft, and the hair healthy by restoring the natural oils from which the hair derives its health, life, gloss and lustre.

ilostora

Try it! See how easy it is to keep your hair combed any style you like, whether parted on the side, in the center, or brushed straight back.

A large bottle of Glostora costs but a trille at any drug store and will last for months.

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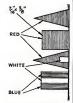
WE FINISH THE

HARTFORD Model

and hoist her battle flags



By Captain E. Armitage McCann



The signal for beginning

This model shows how the Hartford looked early in the Civil War when she was Admiral Farragut's flagship

UR ½-in. scale model of Admiral Farragut's famous soop-of-war Hartford is now nearing completion. This is the last of a series of five articles which began in the January issue.

Our endeavor, after much research, is to make her as she was during the height of her fame in the early 1860's. There is not room to describe every last detail of the rigging, but a few hints should be sufficient if the previously published rigging plan and the various photographs and sketches are carefully studied.

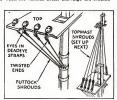
Four thicknesses of black or dark brown cord are used for the standing rigging. These grade from cord about as thick as No. 20 wire for the lower shrouds,

stays, and topmast backstays to the thickness of No. 30 wire for the royal backstays and stays. Hard-laid linen cord should be used. The running rigging (that leading through blocks) is natural flax color or light brown ranging in thickness from No. 22 to 34. The latter is equal to No. 70 thread.

It is wise to make the caps and ship the topmasts before setting up the lower rigging; then the bights will not be in the way. Each cap should be made to fit its mast, so that the masts will be parallel at the doublings. Fiber is the best material, but celluloid or hardwood can be used. Across them lies a current wood can be used. Across them lies a current to keen them clear of the toomast shrouds.

To get the upper deadeyes level, turn in the forward deadeye (starboard side); reeve the

How a mast top and the topmast shrouds appear in the completed model. The maze of rigging will become clearer when the various detail drawings are studied



How topmast deadeyes and shrouds are set up. The futtock shrouds are of soft copper wire



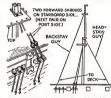
In this unusual view of the model, the rigging seems to tower above the graceful hull

lanyard, bringing the deadeye almost down to position; then take the cord around the mast and down the same side. Hold the second deadeye in its approximate position, take a hitch with the tweezers and, when correct, seize in position and bring both lanyards down together. The next pair goes to port, and so on. Before setting up the rigging, I hitch a temporary stay and backstays to the masthead the mast in position. At the lowermast the stay goes above the shrouds; in every position above that, the stay goes on five they goes and the stay goes and backstay to the mast in position. At the lowermast the stay goes and the stay goes on five the stay goes and the stay goes on five the stay goes on five the stay goes on the stay goes and the stay goes on the stay goes on the stay goes and the stay goes on the stay goes and the stay goes on the stay goes and the sta

The futtock shrouds are next, or they may be put on first. I made these of soft copper wire, fastening them to the futtock band, then taking the ends through the straps of the deadeyes, which project through the tops, and

twisting them underneath

The topmast shrouds should be set up nexwith a grade thinner cord and 5/32-in. deadeves. Then come the topmast stays and backstays. The fore-topmast stay is double. It leads through the bees on the bowspirt and is turned back through botts in the beak and seized. The inner jib stay goes through the jib boom, back under a cleat on the dolphin

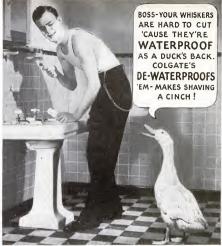


Temporary guys hold masts in position while the shrouds are fastened, one pair at a time

striker, and to a bolt in the bow. The fore-topgallant and royal stays are similarly set up. It is wise to leave all these upper stays until later, because the jib boom is very much in the way. The main and mizzen topmast stays come down through eyes up into, or strapped around, the lower mustheads, about ½ in. 100s and are seized to bolts in the 100s.

At this point it is wise to put on the ratlines (steps). The correct distance apart is hardly more than 1½ in., but I spaced mine 3/16 in., which looks well.

Next ship the (Continued on page 96)





You haven't one single whisker that isn't encased in a tough, waterproof jacket of oil—and that tough, oily jacket is what makes whiskers so hard to cut.



But—if you strip that waterproof coating completely off each and every whisker, you won't have a single reason for saying "ouch" when you shave.



Most shaving creams don't remove that waterproof coating completely — that's what makes shaving hard. For most shaving creams work up into a frothy, big bubble lather—bubbles that are too big to get close to every whisker.

HELP! - I'M SUNK!

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Thousands of these tiny bubbles completely surround each whisker and strip every trace of waterproof coating from it. They emulsify that oily, waterproof coating, dissolve it—and wash it all away.



Then—these tiny bubbles soak each whisker soft. Wilt it. And your razor cuts it slick, clean and without pull. See if it doesn't! Just try Colgate's. Notice how much easier it makes your daily shave. The large 35¢ tube is now only 25¢.

P. S.—For the nth degree of comfort, follow a Colgate shave with Colgate's After-Shave Lotion, and Colgate's Tale for Men.





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A Money-Saving Way to

KEEP YOUR Paintbrushes Clean a short immersion does no harm.

The brushes are wiped with crumpled newspa-pers and then hung in a can of water un-til you are ready to clean them thoroughly

By H.G. Weaver

NE of the biggest problems in the home workshop is keeping paint and laquer brushes in the proper condition. While conventional methods of cleaning are effective, the expense is beyond reason in relation to the typical paint jobs of the home workshop, where in many in-stances more material will be required to clean the brush than has been used to paint the object

Here is a system that has solved the problem for me. It may not be good chemistry and perhaps the brushes won't last so long, but I have been using it almost a year and it saves much time. I no longer dread to be commissioned by my small son to paint a

dozen blocks in as many different colors. Five cans are required. One is for water another for gasoline or naphtha, and the third for wood alcohol. The fourth is left empty as a vessel for doing the cleaning, and the fifth is used for jellied soap, made by filling the can about one third full of soap flakes and then filling it with water and stirring. The can of water is used for keeping brushes

soft until you are ready to clean them. To keep brushes from resting on the bristles, clip a spring type of clothespin on the brush, then put a 10- or 12-penny nail through the coil spring in the clip. This makes it possible to hang the clip and brush on the

edge of a can as illustrated. After using a brush, take a handful of

Brushes are 1 Brusnes water until convenient to go ahead with

2 Wood alcohol is used for clean-ing shellac and lacquer brushes, and gasoline or naphtha for paint, varnish, and enamel brushes. The

be thrown away after using. 3 The brushes are washed in soap jelly and then in hot water



be poured off and used over and over again.

On small touch-up jobs where the soiling of a brush is hardly worth while, I have

found it convenient to use a piece of cotton twisted on the end of a small stick. This can

crumpled newspapers and remove the excess paint or lacquer from the bristles. If you are not quite ready to clean it, clip it with a clothespin and hang it in the can of water. Brushes should not be left long in water, but

The second step is to pour a little gasoline or naphtha in the empty can and wash the brush in it, if oil paint, varnish, or enamel has been used. In the case of shellac or lacquer, pour wood alcohol in the empty can and work the brush around in it. Although wood alcohol is not a perfect solvent for lacquer, I find it works satisfactorily when used while the brushes are still wet. It is well to rinse the brush in hot water before and after this second step.

The third step in either case is to work the brush thoroughly in the can of soap jelly. Then wash in hot water.

The final step before putting the brush away (unless it is a lacquer brush) is to oil the base of the bristles with ordinary cylinder oil. This tends to dissolve and soften any on. Insteads to dissolve and sorten any remaining vestige of paint and insures pliability where the bristles are most likely to become brittle and break off. If brushes are used frequently, the oil should be applied sparingly, but if they are not to be used for a long time, it may be used more freely. It will evaporate over a period of time. I treat my lacquer brushes in

the same way, but hesitate to recom-mend it because even a trace of oil may cause difficulty

when using lacquer. Here's where the economy comes in: The gasoline, naphtha, or alcohol, as the case may be, is poured back into the storage can from which it came and the can covered and put away. The pig-ment settles at the

bottom, and the cleaning liquid may

Oiling bristles at base to keep them flexible

4 A few drops of cylinder oil are applied on the bristles

HOME MOVIES AND HOW

(Continued from page 72)

to become so expert at holding that your friends will think you use a tripod, practice this position till you can line up the finder on a spot on the wall and run the camera (without film, of course) for ten or fifteen seconds without the spot dancing around to any noticeable extent.

In essence, the idea is to convert yourself as far as possible into a rigid camera-holding fixture from the waist up and move the camera as little as possible, and then only by swinging the whole body at the waist.

REMEMBER, too, that the use of a longfocus lens greatly aggravates whatever wabble there may be in the camera support. With care you can get good results using a 2-in, lens and holding the camera as suggested, but if you use a 3- or 4-in, lens, you are sure to get jumpy pictures. A tripod or a very firm support for your elbows is absolutely needed with such long-forus lenses.

The third of the most common faults in home movie making—lack of planning—is easily remedied. Just figure out ahead of time what you want your subjects to do so as to get natural action into the picture.

get natural action into the picture, wish to Suppose for example, that the wish to Suppose for example, that be little playmate. Instead of lining them up in front of the camera and photographing them while they grin sheepishly at the lens, why not have them walk up the street together, talk a moment or two with each other on the front doorstep, and then say goodby as your son's little friend walks out of the picture? This gives you a chance for a long shot as they approach and for a loosed result if you have the children rehearse the procedure at least once while you study the possibilities through the camera's finder.

Give them strict instructions not to look at the camera or to pay any attention to what you are doing. Even if they violate this—and it's one of the most important rules of moviedom—you are certain of a more interesting result than you'll get out of any number of feet of film taken while the two stand and grin at you.

It goes without saying that the best shots you are likely to get of either children or grown-ups are those taken when your subjects are completely unaware that a camera is trained on them.

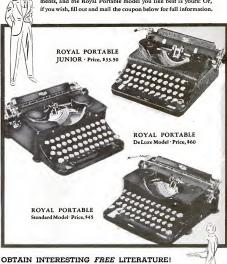
In a future article, Mr. Ryder will explain the tricks of adding titles to your films and show you how easy and inexpensive it is to give this professional touch to your work. If you do not own a motion picture outfil but intend to buy one, took up his previous article "Getting a Start in Home Movies" (F.S. M., Oct. 32, p. 74).

The winter series of photographic contests has revealed a distinct improvement in the work of our readers. For a list of the winners in the January contest, which was the third in the series, see page 95.

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Choose from three models! All are real Royal Portables of latest design and construction. Complete in every respect! Handsome, sturdy, easy to operate—even if you've never typed before! Created for a lifetime of writing convenience to make ideas flow faster, to help busy students do more in less time! See them at your nearest dealer's store. A small initial amount, plus very low monthly payments, and the Royal Portable model you like best is yours! Or, if you make the content had not for full information.



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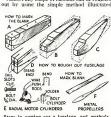


HINTS ON BUILDING

Solid Model Planes

By Donald W. Clark

UILDING small scale model airplanes of the whittled or solid type has become such a universal hobby among boys that the following hints are of fered to help them get more accurate and realistic results. These methods can be used with airplane designs and construction kits of innumerable kinds, but are especially intended for models such as have been described in our own long series. Some of the ideas have been used in past designs, but are shown again for the benefit of those who have not constructed those particular models. Almost any shape of fuselage can be roughed



Steps in cutting out a fuselage, and methods making the motor cylinders and propellers

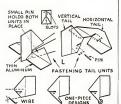
above. Cut and plane the blank to the overall dimensions and mark as shown at A. Saw away the sections marked x, then mark the top plan lines and cut away the remaining excess wood, as at B. At this stage your fuse lage will resemble the one shown at C. It is then easy to shape the cowl and round off the corners. The tail slots should be sawed as at D, before the roughing out is started.

Cylinders of an air-cooled radial motor can be represented with pieces of bolts glued or comented into holes in the fuselage as at E. The propeller may be cut from thin alumi-

num as at F. Clamp the blank in a vise and file to shape. Polish with tine emery cloth. Wing struts are made of either wood or



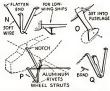
How suitable wing struts are cut from thin metal, and the way to work out wing shapes



TAIL SKIDS Holding the slotted tail units in place with a single pin, and three styles of tail skids

bamboo and glued in place or cut from thin metal, as shown at G, and fastened with small nails or set into slots in the wings or fuselage. The sketch at the left of G shows how the pieces can be flattened between two blocks of

metal. File the rough edges. Wings can be made easily of white pine by marking the profile on each end of the blank (H) and planing down to the line. Next round the tips (J) with knife and sandpaper. Finish by rounding the end to look like K. Wire pins or nails will hold the lower wings to the fuselage



Wheel struts for low-wing transports, small racers, high-wing ships, and fighting planes

An easy and practical way to secure the aluminum or fiber tail units to the fuselage is the slot-pin method shown at L. Two slots sawed in the tail end take the metal parts, which are held tightly with a small metal pin.
The two dimensions marked x and y should



A simple way to represent wheels and pants

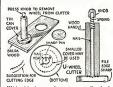
be exactly the same, no matter how far forward the tail parts extend.

Shown at M are three easy ways to make tail supports. The first is merely a bent wire set into a hole in the wood. The second drawing shows how to make the skid and rudder in one piece. The third is similar to the second, but a circle is shaped on the lower end to represent a wheel. Hinge lines, hinges, and names or numbers can be put on the painted surface with a pen and India ink, A finetoothed hack-saw blade is best for cutting slots in wood and metal parts.

The wheel-strut sketches show four simple ways to represent the popular split type land-ing gear. Thin metal is used in the ones shown, and the strut ends are bent and have holes which take small nails, N is intended for low-wing transport planes, O for small racers, P for high-wing monoplanes, and Q for army and navy planes. The latter is suitable for any type of airplane of standard size and can be made of two pieces of thin metal. The sketch shows only the left half of the

gear. Wheel pants can be made easily of white pine or balsa wood. Draw the profile on a piece of wood thick enough to allow for both pants. Shape to the line, saw in two as shown at R, and round the edges with a knife and sandpaper. Cut a single wheel in two and glue the halves to the bottom of the pants as at S. The way the assembly is attached to the

strut is shown at T. The drawings at U show how to make a wheel cutter. The design was suggested by Don Couse. The wood handle has a hole drilled through its center to take a large nail, the upper end of which has a coil spring and a wood knob that fits tight. There is a recess for the spring. A small tin cover from an ad-hesive-tape or bouillon-cube can serves as a cutter and is held on the handle with two



With this homemade cutter, small wheels can quickly be made from thin, soft balsa

screws. By removing these screws, the knob, and the spring and sliding out the nail, a different sized cutter or cover may be attached. A centering pin inserted in the nail head as shown makes it easy to cut the blank from the reverse side also. Place the cutter on the balsa wood, push down the knob, and press down on the handle while turning it back and forth in short strokes.

BROKEN FILE KEEPS WRINGER CLAMPS FROM SLIPPING

When a hand-power wringer is fastened to the partition between two stationary tubs by means of two clamps in the usual way, the clamps are likely to slip off, and when they do, someone may get hurt. I remedied this fault by inserting two short pieces broken from a mill file between the faces of the clamps and the tub wall. The teeth of the file enable the clamps to hold the wringer securely.—Eugene Amstus.

HOW TO CUT RUBBER FASILY

IN CUTTING up old rubber inner tubes or other rubber articles, they should first be moistened with a solution of equal parts water and glycerine for best results. After this treatment a knife or scissors will cut through any reasonable thickness without wavering from a straight line,-K. E. N.



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and condition of mowers. New attements also
experiences are successed to the start of the start
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Now is the Time to Start



South Bend

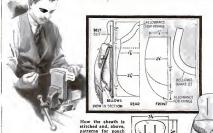
The 9" x 3' No. 5" WORKSHOP" LATHE is a Back-Ceared, Screw Gutting, Metal Working Bench Lathe with automatic longitudinal feed; graduated compound rest; hollow headstock spindle; cuts threads f1040 per inch. Counter-shaft and Motor Drive Types. Operates from light socker. Write for Circular No. 3-W.



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Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

Pouch on Knife Sheath HOLDS CANOEIST'S KIT



ECAUSE he affects a scanty garb, the canoeman is as shy on pocket space as an Indian. Usually, however, he carries a strong, sharp, short-bladed sheath knife,

so if he adds to the belt sheath a leather pouch of moderate size, his worries about the stowage of little things are about over. To support the pouch properly, the back of the sheath should be made of stiff leather

334 in. broad by from 1/16 to 1/8 in. thick The remains of an old brief case will provide excellent material. A piece of similar material about 2 by 55% in, length is needed for the front. Shape these pieces as indicated, soak them for ten hours, and, laying the front of the sheath in position, pierce for sewing at 1/16-in, intervals. The line of stitching that will later hold the pouch to the sheath goes across the back and top front of the sheath, and these piercings should be made before sewing the sheath itself together.

Wooden jaws are convenient to hold the leather, saddler fashion, while stitching. a waxed end, two needles, and an interlocking stitch. Small copper rivets are driven just inside the line of sewing to protect the wearer

and the thread from an accidental cut. While the leather is still soft, punch four 1/8-in, holes where the ends of the belt slots will come and, using a ruler as a guide, cut the slots, which should be 1/16 in. wide.

The pouch can be made from a variety of materials, buckskin heading the list. Two of mine have been made from women's cast-off pocketbooks or hand bags of large size, and a third from suede leather. Any of these can be sewed on a machine with a strong needle provided care is exercised.

TO MAKE the bellows, cut two U-shaped pieces according to the half pattern given. Then stitch the inner edges together, and sew on the back of the pouch as shown. You will have to work slowly to get the front on correctly, for the back has to be held out of the way, and the allowance left for the fringe will get in the way. Now slash the allowances to make the ornamental fringes. Each segment should be approximately 1/16 in. wide

A bright, roundheaded button, fitted rather tightly in a buttonhole cut in the flap, completes the pouch. The button should be placed well down on the front to assure a tight-fitting flap, and the pouch may be made tignt-atting nap, and the pouch may be made more secure by the addition of a small sized zipper-type fastening, which is sewn to the threads holding pouch and sheath together on one side and to the lip of the pouch.

Sheath with pouch added and, at left, the sheath itself To make the sheath safe and prevent loss of the knife, it is well to fit a protecting wooden case within the leather. Mark the

blade outline on a piece of white pine 1/2 by 134 by 6 in. Gouge out until the knife lies for half its thickness within the cut. Make a similar piece and fit the two together so that the blade binds when slipped into the recess between them. Now dress the outer faces until the total thickness of the wooden case is little more than 3/16 in. (thickness of blade more more man 3/10 in. (thickness of blade excluded) and is elliptical in cross section. Smooth with sandpaper, and shellac inside and out. When dry, apply shellac again and slip immediately into the sheath.

IF DESIRED, a still further precaution against the loss of the knife may be taken. Remove the recessed portion of the button snap from an old glove, measure the length necessary to encircle the knife handle just below the knob-measuring from the projecting portion of the snap-and reinsert the recessed half of the button at this point. Now cut out the section of the glove containing the snaps in such a way as to form a strap ¾ in. wide by about 2½ in. long, leaving quite a little extra leather projecting at the recessed end of the snap. Rivet this to the back of the sheath between the belt slits and well toward the top where it will grip the handle of the knife. This will hold it to the side, keep it down in the boot, and prevent it from slipping out even if you stand on your head.

As for contents, my pouch contains the following: A flat tin, formerly an aspirin box, enameled bright red and containing paraffined matches; small compass; sample size tube of ungentine; small roll bandage; length of strong fishline; tweezers for pulling splinters; very small side-cutting pliers; envelope with casein glue; roll of adhesive tape; small razor-sharp penknife; flat tin box containing tacks, copper nails, shingle nails, small screws, screw eyes, cabinetmaker's fastenings, thumb tacks, fishhooks, split shot, staples, piece of beeswax, paraffin, and rosin.—Jack Hazzard.

HARDWARE FROM HINGES AND BAND IRON

(Continued from page 71)
the hinge is finished and mounted, the un-

usual form of construction is not noticed. The strap hinge with both ends of the finhail design shown in the upper center of the group was also made from a steel T. The strap will be strap the strap of the strap with the countersunk holes in them, and then hammering out the straps on the amil to obtain the fishtail or fan-shaped end. The edge was worked from the topside with the hammer to obtain a low chamlered face of the strap was also lightly hammer-marked. The flat, slightly rounded face of the strap was also lightly hammer-marked. The flat, slightly rounded face of the strap was also lightly hammer-marked, the flat will be succeeded to the hammer is used for this, not the hall peen, which gives a pock-marked effect rarely notices were filled.

THE strap hinge with the leaf-shaped ends (lower center) was made in the same way except that each side of the strap was cut away with a cold chisel or filed.

was cut away with a cold chisel or filed.

The barrels of all the hinges were chiseled over with a small, sharp cold chisel to obtain long facets resembling hammer marks (illustrated in circle). It is not practical to hammer a finished hinge barrel.

The strap or drawer handles shown at the top and bottom of the group were made of hand iron slightly less than ½ in. in thickness, the ends being cold forged and the handle part formed in the vise. The key plate is a short length of band iron, forged, notched, and drilled. The pull handle shown at the upper left of the group was made in the upper left of the group was made in the proper short of an anvil or on a round steel bar held in the vise.

All these fixtures are screwed to the wood-work. As most commercial forms of hinges have countersunk holes in them, the newly drilled holes are countersunk also. Flathead will be recommended to suit the pieces by fining the heads slightly round and by filing the facets on them as shown in one of the photographs. This gives the screws a much more attractive finish. Roundheaded screws heads of stove botts.

These pieces are painted dead black as is usual with wrought iron. First, all dirt and oil are cleaned from them. A very durable finish may then be applied as follows: Paint the cleaned steel with aluminum bronze powder mixed with clear brushing lacquer to the consistency of thin cream. When this is thoroughly dry, brush on a coat of ordinary dead black paint, following this with a second coat when the first is dry. The paint second coat when the first is dry. The paint by purchased ready mixed or made by the proposition of the proposition

USING COMMON PINS FOR DECORATIVE PURPOSES

By ProvIDING them with heads of any desired color and shape, common pins can be used for various decorative purposes and in used for various decorative purposes and in part white roshio, noe part fine white lead in powdered form, and coloring matter. The following pigenests are suitable for coloring: chrome yellow; Turkey red; chrome green; ultramarine (for blue); and a mixture of these to obtain other shades and tints, the mixture to cool in the form of sticks, which will be quite hard. Cut off a small piece and touch a heated pin head to it. The material will adhere and may be formed into a ball by twiring over an alcohol lamp.



Another expert tells how sharp tools help him make a living

IN Norwalk, Connecticut, W. Thurston DeGroff makes his living huilding scale model airplanes to special order.

These planes are exact replicas, in every detail of scale, line and color. From the detail of scale, line and color. From the stream-lining of the stratus to the proper sairfoil in a wing, they are so perfect that leading aircraft firms, like United Aircraft, Sikorsky and Fleet, luny his models for ex-hibition and sales purposes. Also among his customers are many well-known sportsmen pilots who want accurate and beautiful models of their own planes.

Recently Mr. DeGroff wrote us the following letter:

"In my type of work good tools and sbarp tools are a necessity. Success depends on the accuracy of my models. In six years' experience as a model maker I bave found that Carhorundum Sharpening Stones will give you every time that characteristic, keen razor blade edge on your tools that every woodworker craves."

Mr. DeGroff knows what he's talking about. It's his husiness to know. Dull tools would mean poor, unsaleahle models—and, as he says, would cost him money.

Most of you don't earn your living this way, but you do bave edged tools in your workshop and you do like to turn out good work. Take the advice of another expert—all the skill in the world is wasted on dull knives and chisels. You'll do better, faster work with sharp tools.

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THE NATIONAL HOMEWORKSHOP GUILD

(Continued from page 60)



William E. Mitchell, president of the Spokane Homecrafters, and a combination desk and cabinet file he has just constructed of solid walnut

been made with the emblem of the National Homeworkshop Guild. At the end of each Homeworkshop Guild. At the end of each so home the next meeting is to take place, and on that evening he displays it in front of his house. It is at once a symbol of the Guild and a sign that saves the members looking for house numbers on a dark night.

Harold Rickman gave a demonstration on the use of the drill press at a recent meeting of this club, and the lathe was made the subject of another meeting held in the workshop of

Dr. H. O. Harris.

The Spokane Homecrafters of Spokane,
Wash., under the enthusiastic leadership of
William E. Mitchell, have received a number
of applications for membership and will soon
have a waiting list unless new arrangements
for a meeting place are made.

"Our homecraft club was the cause of putting one dent in the depression," Mr. Mitchel writes. "One of our members, following our last meeting, spen \$120 cash for home workshop machinery, and he is all 'hopped up' and going strong. One club session lasted for four hours, which will give an idea of the interest shown. The wife of one of the members called up and wanted to know if he was ever coming home again!"

F. Clarke Hughes, who has contributed many articles to Popular Science Monthly, gave a talk at one of the recent meetings of the club.

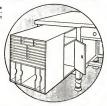
Mr. Mitchell, who is nearly seventy, has been building furniture as a pastime for many years. He has just

completed a conbination desk and cabinet file shown in two of the accompanying illustrations. The desk is of walnut throughout. The top was made by doweling and gluing together 4 in. wide strips. The typewriter slides out as shown, and there is a filing



and uphoistered in royal blue leather.

The Marshalltown Homeworkshop Club of Marshalltown, Iowa, started with 24 charter members and has a (Continued on page 91)



What Hobbies Are Represented in Your Club?

Several clubs have taken a poll to discover the favorite hobbies of their members. One man, for example, devotes his spare time to making Indian headdresses. Find out how many hobbies are represented in your club and send the list to the Guild Editor, Poortlas Science Abovente, 38 I Fourth Avenue, New York, N.Y.



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HOMEWORKSHOP GUILD

(Continued from page 90)

prospective membership of from 60 to 75. It has appointed a committee to investigate the feasibility of acquiring a club workshop.

An excellent method of assisting club members with their individual problems has been worked out by the Madison Homeworkshop Club of Madison, Wisc. It has started a ques tion box and printed suitable forms for distribution at each meeting to those who have a question or problem to solve. These questions are then distributed to craftsmen who are qualified to answer them. A short but complete report is read at the next meeting.

New Clubs Apply for Charters

Here is the official list of new home workshop clubs that have been organized and have applied for charters in the National Homeworkshop Guild:

Ashtabula Homeworkshop Club, Ashtabula, Ohio Austin Homeworkshop Club, Austin,

Beckley Homecraft Club, Beckley,

Center Homeworkshop Club, Smith Center, Kans. _The Dalles Homeworkshop Club, The Dalles Ore.

Denison Homeworkshop Club, Den-

Erie Homeworkshop Club, Erie, Pa. Fox River Homeworkshop Club, Sheridan, III.

Sheridan, III.
Kalamazoo Homeeraft Club, Kalamazoo, Mich.
Maddock Homeworkshop Club,
Maddock Homeworkshop Club,
Maddock Homeworkshop Club,
Marshalltown, Iowa
Mid-Hudson Homeworkshop Club,
Poughkeepise, N. Y.
New Egypt, Home Workshop Club,
New Egypt, N. J.

New Egypt, N. J. Queen City Homeeraft Club, Elmira, N. V.

Sawdust and Shavings Homeworkshop Club, Yreka, Calif.
Shenango Valley Homeworkshop Club, Sharon, Pa.

Tucson Homeworkshop Club, Tuc-

Wood Crafters Club, Richmond, Ind. These clubs are in addition to those listed in Previous issues of Popular Science Monthly.

The Topeka Homeworkshop Club of Topeka, Kans., has received so many questions in regard to eligibility for membership that it has announced in the newspapers it will wel-come men interested in photography, radio, chemistry, astronomy, microscopy, and sim-ilar hobbies. Russell Fairchild, a cabinetmaker, exhibited an unusual collection of rare woods at one meeting of this club.

The Amarillo Club has made arrangements to hold woodworking and metal-turning classes in the senior bigh school under the leadership of various manual training teachers. The use of the shops and machines is given by the board of education, and the teachers' time is covered by a small fee col-lected from each member. The schools are also cooperating by offering to sell hardwoods to the memhers at a low price

One of the recent meetings of this club was held in the United States Helium Plant, where a demonstration in metal turning was given by John Odom, who is connected with that plant. Dr. C. W. Seibel, chief engineer of the plant, is also a member of the club.

At a meeting of the Amateurs' Homeworkshop Club of Richmond, Va., G. H. Smith gave a demonstration in plain and fancy wood turning, and a (Continued on page 02)



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MAY, 1934



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Automobile Racing-NEW BOOK!



THE NATIONAL HOMEWORKSHOP GUILD

(Continued from page o1)



number of samples of rare and imported

number of samples of rare and imported cabinet woods were placed on exhibition. A variety of beautifully veneered pieces of woodwork were exhibited by J. W. Buchanan at a recent meeting of the Tucson Homeworkshop Club of Tucson, Ariz. A gavel for L. A. Raymond, president of the club, is to be made by Mr. Buchanan from a piece of ironwood

Keep a Photo Record of Your Club



WHEN your club makes or does something unusual interest, have some photo-graphs taken and keep them in an album as part of the elub records. Send the best

of them to the of them to the Guild Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, N. Y. As many as possible will be published in the magazine. There is almost certain to be at least one expert photographer among the members of your club, and he will know how to take pietures that have the qualities of clearness and human interest.

donated by Harold E. Cochrane. W. O. Watkins, secretary of the club, showed a number of airplane models in various stages of con-struction and several finished models. This club has made a point of encouraging every member to bring some piece of craftwork, whether finished or unfinished, to the meetings.

The Timpanogus Homeworkshop Club of Provo. Utah, held its last meeting in the mechanic art shop of the Provo High School. Matoni Cottam gave an instructive demonstration of the use, sharpening, and care of woodworking tools

woodworking tools.

The Cheyenne Hobby Club of Cheyenne,
Wyo., held its organization meeting in the
junior high school. Edward L. Kopp, Jr.,
the secretary-treasurer, suggests that every club start a scrapbook for newspaper clippings. He has already done so and believes it will be

an exceedingly interesting volume to look over in the years to come. Three members of the Rockford Homecraft Club-Reginald Alcock, James Burns, and Frank Burritthave just completed a 14-in. band saw made in its entirety in their home workshops. This is shown in one of the accompanying photo-graphs. They made their own patterns and all the necessary castings, the latter being entirely of aluminum. Mr. Burritt had previously done a good deal of experimenting in casting aluminum in his basement shop. None of the men, however, had special experience in this particular line of work, yet the saw is an excellent machine from the standpoint of design and craftsmanship.

William H. Stewart, who organ-inzed the club in Kalamazoo, Mich., has long been identified with archery and has been an active worker among Boy Scouts. LeVern T. Ryder, president of the Guild, is an archery enthusiast, and the lists of hobbies sent in by various clubs al-most always show that some members have taken up the hobby of making bows and arrows.

A check-up made among the members of the Beckley Homecraft Club of Beckley, W. Va., revealed that the hobbies of the members included woodworking, ornamental metal work, wood turning, archery, and model mak-ing. There is a physician, an optometrist, an architect, a lawyer, an officer of a collecting agency, an automobile mechanic, a machinist, a bookkeeper, a newspaper circulation agent, a railroad man, a high school instructor, the chief of police, a criminal court judge, and a student among the members.

Harold Gessert has been elected to fill the vacancy in the office of secretary-treasurer of the Janesville Homeworkshop Club of Janesville, Wisc. Alan W. Dunwiddie is the president of that club.

The interest that has been caused throughout the country by the Guild is reflected in the large number of newspaper clippings that are being received at Guild headquarters and at the offices of Popular Science Monthly.

A long leading editorial in the Stamford (Conn.) for its clear, thoughtful, and encouraging antor its clear, thoughtful, and encouraging analysis of the advantages of the Guild. Thanks are also due to Andrew R. Boone of Los Angeles, Calif., for his excellent presentation of the advantages of the Guild in various Pacific Cosst newspapers, and to C. A. Achtonews of the Guild in various the control of the Control o

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HOW TO MAKE A SET OF MUSICAL CHIMES

(Continued from page 65)

provided for it in the block. Approximately 2 oz. of wire will be required for the coil.
Force the coil into the 1-in, hole in the wood block so that the ends of the coil are the same distance from the outside edge of the hole. To hold the coil firmly in place, pour some shellac around it through the hole in the terminal recess. Secure the coil ends to the terminal screws, which are made from 1/2-in. No. 8 roundhead wood screws

and small brass washers, as shown in Fig. 1. The details of the plunger are shown in Fig. 7. It is essential that the dimensions be adhered to in making the plunger, also that brass and iron machine screws are used where shown. Although the plunger should not be inserted in the coil until after the coil is in place, an assembled view of the coil, plunger, and springs is given in Fig. 6 to indicate the correct assembly. The spiral



DECORATIVE FRONT COVERING BOARD Method of winding the springs and adjust-ing the tubes, and a suggestion for a cover

springs are wound on a round piece of wood, tapering at the end from ½ to ¼ in., with a slot at the small end to hold the Since the strength of the springs will wire depend upon the voltage of the transformer. it is advisable to make the springs with five or six turns and then cut away portions of turns until the correct adjustment is obtained. A drawing shows the method of winding the springs.

After the plunger has been inserted in the coil, the brass tubing should be suspended from the adjusting screw. The tubes used by the writer consist of No. 18 seamless brass, 1 in. in diameter and 33 and 36 in. long respectively. While that combination less combinations that will be equally satisfactory. Gage, diameter, and length may

all be varied to suit the individual fancy, Loop a piece of heavy cord through holes in the tubing, as shown in Fig. 8, and hook it over the end of the adjusting screw which has been pushed through the 5/32-in, hole in the end of the block. Force the screw into the inside hole and secure in place by slipping the retaining plate over the circular slot in the screw. Fasten the plate to the block with small wood screws. If the retaining screw is (Continued on page 05)

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The parts of the jig and, at left, how it is used to bend sheet metal

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The two main bars constituting the body of the machine are 1/2 by 2 in. square-edged bar stock, either iron or cold-rolled. The top member is beveled along one of its long edges at a 45-deg, angle for making sharp bends and seaming laps. The lug on the bottom bar, for holding the clamp in a vise, is a piece of the same stock 2 in. long, either welded or bolted with countersunk machine screws to the center of the bottom bar and at right angles to it. The bar should now be bent slightly upward in the middle or given a slight camber, say 1/16 in. or less, so that it will grip the metal to be bent firmly in the center of the

clamp. The bolts are 2 by 5% in, U.S.S., either welded or threaded through holes 1 in, from either end of the bar on the center line. The upper or beveled bar has two slots 3/1 by 11/4 in., one at either end of the bar, to slip easily over the 5% in. bolts in the lower bar. The back edge of these slots-that is, the edge on the side opposite the bevel-should be 1/4 in. from the back edge of the bar. The reason for this will be explained presently. Two heavy 13/2-in, washers and two nuts complete the assembly.

In use, the clamp should be firmly gripped

in the jaws of a vise, the nuts loosened, the sheet metal inserted between the jaws of the clamp, and the nuts tightened firmly. The bends should be made upward rather than downward, as by this means you can make several bends-the four sides of a box, for instance-without having the metal strike the vise.

Since the slots in the beveled bar are off center, you can slide the beveled bar backward and forward across the lower one so that about 5/16 in. of the lower bar will remain exposed, either on the bevel or the square side, thus forming a little ledge, Unless the edge to be turned is very small, you can start the bend with your hands, bringing the metal into a nearly vertical position; then-and here's where the little ledge comes inuse a small block of wood and a hammer to drive the metal back against the upper bar. Slide the block of wood along the ledge while holding the block parallel with the upper face of the lower bar. This will give a sharp, clean

The capacity of the clamp shown is 9½ in, between the bolts, but there is no reason why this could not be increased several inches. For still greater capacity it would be advisable to increase the size of the bar stock.

A convenient open-end wrench for tightening the nuts can be made from an old T-model spark-plug wrench simply by cutting it in half.—R. Gerald Bullard.

MAKING PLASTER SET SLOWLY

IN MIXING plaster it is useful to have on hand a saturated solution of tartartic acid. One drop added to each glass of water used for mixing the plaster will delay it from setting for from one to two hours.-E. T. H.

MOLTEN NITRATE COLORS TOOLS BLUE

HAT steel-blue color of the newer razor THAT steel-blue color of the news and blades can easily be reproduced on small tools such as wrenches and on angle pieces, rivets, and various small steel fittings. The process consists of exposing the iron or steel article, which must be free from rust, to a definite temperature that favors the for-mation of this particular blue-colored iron oxide. This is accomplished by immersing the article in molten potassium nitrate or sodium nitrate. The chemical can be melted in a tin can, using the heat from a Bunsen burner. The flame is then lowered, and the article immersed. This will chill the molten chemical and form a crystal covering on the metal, but increasing the heat slightly will cause the coating to melt. Too high a temperature is not desirable. If the chemical is just kept molten, this automatically controls the tem-perature. The work is allowed to remain for a minute and is then removed and cooled,



The tool is merely left for a minute in a ath of molten potassium or sodium nitrate

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HOW TO MAKE A SET OF MUSICAL CHIMES

(Continued from page 93)

now turned, it will be noticed that the cord will ride in the grooves on the screw, causing the tube to move either toward or away from the plunger. The complete unit may be permanently secured by means of a long wood screw after the circuit wires have been connected to the terminal screws.

The coil and plunger are designed to work satisfactorily on 10 volts, alternating cur-rent, but it will be necessary to provide a higher voltage if the bell-circuit wires are of small diameter or are unusually long. The standard type of doorbell transformer in common use everywhere is designed to give 10 volts, but for a few cents moreall doorbell transformers are very inexpensive—it is possible to obtain one that has several terminals, giving 6, 12, or 18 volts, as desired.

Plunger and tubes should be so adjusted that when the push button is pressed there will be one clear note sounded, and when the button is released another note will be sounded. If the plunger makes a vibrating sound instead of a single stroke, the tube is too close to the plunger. If the return stroke when the push button is released is sluggish, it will be necessary to increase the ten-

sion of the spring on the return stroke side. If it is desired to cover the face of the unit, a plate may be cut from a piece of mahogany or other hardwood 3/8 or 3/2 in. thick, as shown, and finished with stain and shellac

Mr. Ford built his own transformer to operate the door chime. For the benefit of other electrical experimenters who wish to do likewise, he will describe the transformer in a following article.

More Prizes Awarded for Good Photos

THE third in our winter series of indoor photo contests (P. S. M., Jan. '34, p. 68) brought in a surpris ing variety of excellent pictures. Prizes have been awarded as follows in that contest:

FIRST PRIZE, \$25 Charles J. Belden, Pitchfork, Wyo. SECOND PRIZE, \$15

C. A. Briggs, Washington, D. C. THIRD PRIZE, \$5

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Leo Leonard, Edwardsville, Pa.; Mrs. W. A. Miller, Cadillac, Mich.; H. M. Streeter, Towson, Md.; Mrs. Mildred M. Keeton, Munising, Mich.; Howard Porter, Monteguma School, Los Gatos, Calif.

HONORABLE MENTION-Teen Becksted, Chicago, Ill.; Boyd V. Evans. Philadelphia. Pa.: Frank Lein-Evans, Philadelphia, Pa.; Frank Lein-haupel, Chicago, Ill.; Lavilla Perry, Salem, Ore.; Mary Wright Pridham, West Palm Beach, Fla.; H. D. Rus-sell, Rochester, N. Y.; Elmer Reed, La Grange, Ill.; H. H. Schoenlank, Chicago, Ill.; Jack Sherman, Toronto Ont., Canada; J. M. Stofan, Gar-field, N. J.; Wm. H. Tourtellotte, Webster, Mass., and H. C. Warner, New Castle, Pa.

Winners of the February contest will be announced next month.

TAKE THE GRIEF OUT OF EMERGENCY REPAIRS

A sudden leak in the heating boiler-the hammer handle flies of -water squirts from a dent in the auto radiator-a drawer knob pulls

out - screws strip from and loosen the door lock-a water pipe freezes and cracks - one caster won't stay in the table leg-your favor-ite pail starts to leak -a persistently loose nut puts the vacuum cleaner out of business-etc.-etc.



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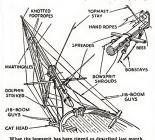
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WE FINISH THE HARTFORD MODEL

(Continued from page 83)



the jib boom is reeved through the cap, lashed, and guyed

topsallant masts and set up the topsallant rigging. This is seized together at the mast-head, comes down through holes in the ends of the crosstrees, and has the ends seized or hitched to a futtock-bar, which can be a needle through the topmast rigging, It is desirable to put rathines on this rigging too. For the eyes in the topsallant and royal back-says at the mastheads, I used a long seizing, the seized of the mast the down from the sides of the masts.

Some of the stays come to eyebolts in the caps, others to bolts in the mastheads, as shown on the rigging plan. I first set up the stays temporarily, then the backstays, and finally tighten the stays again.

The spencer gaffs should go on next. The goosenecks are set in the eye bands on the masts. The peak halyards start at the end of the gaff, pass through double 3/16-in. blocks botled to the tops, down through boils (or blocks) in the deck at the side, and to the pinrail. Two ½-in. blocks are selected to the end, and through them lines are rove and belayed to the sides to the prisers the vangs.

The spanker gaff is similar except that the peak halyard reeves through two single blocks strapped to eyes on the masthead. The vangs belay to cleats on the deck.

The ends of the fore and main yards require 3/16-in-blocks above and abaft. The topping lifts start at the single yards are blocks, reeve through a double block, round again, and down through the sheet rever them off first, then sette the awkwardly placed block in position, in this case to the arm on the cap. When these are rove, I put the plin in the truss and stretch the sline chain to the bolt in the middle.

The crossjack yard is similarly rigged except that the brace blocks are on the foreside. This applies to all the mizzen yards. The braces I leave until last.

For the topsail yards one needs brace blocks and standing lifts, which are single lines from yardarm to yardarm with sufficient slack to allow the yards to lie ¼ in. or so above the caps. To the center bolt, a light chain is fastened, which reeves through the hole in the

mast. To the afterend of the chain is fastened a ½-in. block, through which is rove a heavy cord, one end of which is botled to the deck while the other ends in a double block that is connected with a takele to a triple block at the deck. This end finishes at the triple block and leads up to the pin-

rail.

Topgallant and royal yards are rigged much the same. Cord can be used instead of chain for the ties. It comes down to two double blocks for the topgallant, and to a double and a single block for the royal halvards.

The fore-topsail halyard tackle is to port, and the halyards then alternate as they go up. The main halyards are on opposite sides, and the mizzen reverse again.

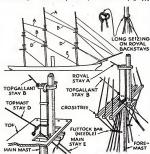
and gayed

The lead of the braces can be seen on the rigging plan. I start reeving them from the top. All hauling parts lead down abut the masts and are as straight as possible. Royal, single, come to the Topsail braces belay amidships. Forchraces run to the sides from blocks bolted to the cheeks; main braces from blocks on the stern galleries to the pinrail; and crossjack braces lead to the sides through blocks seized to the

rigging.

Before reeving the braces, we should rig out
the jib boom. It reeves through the cap and
is lashed to the bowsprt just outside the cleat.
The guys come from the first and second
stops. I split the rope to form cut splices to go
on the boom, then hitched them to the spreader
and turned them back through the bolts in the

Catneads. The dolphin striker must now be set up. A light chain comes from each stop of the jib boom, the bight being seized to the eye at the come the dolphin striker. From the other over the control of the control



Position of the various stays, which are set up as soon as the topmast shrouds are on, and methods of fastening them



Squabs UP cold bottle, bot bird now; in de-

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Did You See ' Page 101

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THE HARTFORD MODEL

(Continued from page 06)



holes in the crosstrees to a futtock bar

either side, slung from the end to the legs of the fore-topmast stay, with stirrups at the in-ner stop, and one knot or bead outside this and two inside. There is also a hand rope from bolts in the cap to others in the cap rail. These are sometimes cross-laced for the staysail to

It would presumably be correct to have a netting under the jib boom from the end to the spreader. This can be made of tarlatan or mosquito netting stiffened with black shellac At the mastheads there should be small

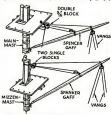
round trucks, gilded.

The anchors are of the usual type 11/2 in. long, with wooden stocks. The bowers are hung from the catheads by the stoppers with one with a short chain to staples. Their chains lead in through the forward hawse pipes along the

The sheet anchors, as shown in the photographs, are not exactly in the right place. The palms should be shifted a little forward to rest on the rail, and the stocks should lie horizontal and be lashed in position so as to clear the

gun ports. The chains lead to after pipes. There are five boats. Two 33-ft. launches or longboats hang in iron davits amidships. The davits swing in sockets and bands outside the hull. The boats are hung with twofold tackles and belay to cleats on the davits. A boats are hung with twofold spar should be lashed across the davits against which to bring the gunwale, as the boats are lashed to the davits with the gripes (the lines passed around the boat to prevent swinging). A span carried across the davit heads and brought to the rail will complete the assembly.

Two 29-ft. whaleboats are hung from wooden spar davits in the mizzen rigging. These spars set in shoes (Continued on page q8)



Spencer and spanker gaffs. Note difference in arrangement of their peak halyard blocks

"EVEN HIS WORST FRIENDS TOLD HIM!"



THEY SURE DID-when they recovered! But recovering from the K.O. of that sullen, soupy pipe was harder than holing a golf ball from a sand trap!

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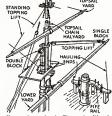
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WE FINISH THE HARTFORD MODEL

(Continued from page 07)



How yards are rigged. The topping lifts wer yards are carried down to the deck

on the channels and are suspended by a span from high up on the rigging.

A 24-ft. cutter hangs over the stern from iron davits. These are shorter than the others and swing in sockets on the quarters. The hoats are all black outside, with gray bottom boards and with the thwarts and everything above white.

In a future issue we intend to describe in detail the making of ship's hoats for any type of scale model in which extreme accuracy is desired.

The base for the Hartford can be two uprights made to fit at sections 5 and 11, as shown in one of the drawings. One or two crosshars are used to connect them.

The correct ensign for 1863 has thirteen stripes and thirty-five stars. The United States Navy Department has informed me that David G. Farragut as senior rear admiral (he was made full admiral in 1866) hoisted a plain hlue flag at the main of the Hartford, his flagship, at New Orleans on August 13, 1862, it being the flag he had previously flown at the

From the United States Navy signal book of 1859 was taken the signal for commencing battle, which was to be hoisted where best seen. This we ran up at the mizzen. As far as we are concerned, no doubt a signal for ceasing hattle might be more suitable, because the model is now finished. I am sure that if you have worked carefully, everyone will salute its blue flag and say, "Well done."







The boats of the Hartford and a diagram of a stand. Only half of each cradle is shown

TRAILER RACK FOR CARRYING BOAT

(Continued from page 67)

List of Materials for Boat Rack

- pc. 34-in. I. D. (inside diameter) iron pipe, 5 ft. long, for uprights and cross-
- pieces.
 pc. 34-in. I. D. iron pipe, 6 ft. long,
 for rear uprights.
 pc. 34-in. I. D. iron pipe, 9 ft. long,
 for lengthwise members.
 pc. 36-in. I. D. iron pipe for 18-in.
- pc. 3%-ir brackets.
- brackets. three-way pipe ells, ¾ in. flanges, ¾ in. pc. 2 by 4 in. by 6 ft., oak or yellow pine, for crosspieces. pc. 1½ by 1½ in. by 6 ft., oak or yellow pine, for clamping pieces. pc. 5/16-in. iron rod, 24 in. long, and
- 4 nuts. machine bolts 1½ by ½ in. for brackets. machine bolts 1½ by ¾ in. for bumper fittings.

 machine bolts 3 by ½ in. for wood
- frames stove bolts 11/2 by 1/4 in, for fastening flanges.
- shown in the drawing. The hoat, resting upon these shaped pieces, will shift about less. A clamping device to hold the boat secure-

ly to the rack is made of 11/2-in, square oak or yellow pine of the same length as the cross-pieces. Place the boat on the rack, lay the clamping piece over the top of the hull, and cut to the right length two pieces of 5/16- or 3/s-in. iron rod. Allow 11/2 in. of the rod to project above and below the pieces. Thread the ends of the rods for 2 in., and drill for the rod at points 2 in. from the ends of the clamp piece and lower crosspiece.

Brackets for the rack are made as shown

of 3/8-in. inside diameter pipe flattened on the ends. The flattened ends are drilled and secured to the pipe frame with 11/4 by 1/4 in. machine bolts. For extra rigidity, brackets in the rear may be found necessary.

Rowhoats and runahouts with wooden decks may be secured forward with a clamping piece such as has been described, but it will be necessary to tie the forward ends of boats that have light decks.

Old inner tuhes, sacks, or blankets may be used to pad the front and rear crosspieces.

Canoes and round-bottom boats are best carried upside down. If the hull is transported right side up so as to carry luggage within, a padded cradle is constructed. A canvas cover may he made to protect anything carried in the hull in bad weather.

REMOVING GUMMED OIL

WHEN it is found that the oil used to lubricate mechanical parts has hecome gummy, remove it with a strong lye solution applied with an old toothhrush. Rinse off the parts with water, then apply alcohol to remove water. Oils that gum up do not lubricate well; use only the best highly-refined oils.-E. T. H.

HOW TO MAKE ORIGINAL BORDERS FOR PHOTOS

WITH a good camera, a little artistic ability, and developing facilities, an amateur photographer can make his own border prints.

First, decide upon the design. The initials of the photographer may be placed in the corner, and other features added. This bor-der is then drawn on drawing paper with black ink. Care should be taken in getting the right proportion of width and breadth in the drawing, and it should be made as

large as convenient. his drawing is mounted on a drawing board or other flat surface with thumb tacks and a negative made. The drawing may be illuminated with flood lights, a flash bulb, or sunlight. Care should be taken in getting the right focus. The image of the border should be the exact size of the desired border on the prints. If the camera is not provided



The large drawing, the method of doing the printing, and two examples of final result

with a ground glass screen, the back of the camera can be removed and a piece of ground glass or paper inserted for focusing. When the film or plate is developed, it will be noticed that the negative is dark except for the clear lines of the border pattern. The inside of the border is cut out with a sharp knife or razor blade along the dotted lines marked A. This negative is then placed in the printing frame.

The negative to be printed should be no

larger than the border itself and should be placed in the frame so as to be just inside the border. A piece of printing paper is placed over the negative and border negative as shown at B. The print is then exposed to the light and developed in the usual man-

ner. The finished print was around it as shown at C.
Another type of border is shown at D.
An unexposed film or plate is placed face downward over the border negative instead of printing paper. This is exof a piece of printing paper. This is ex-posed to the light for only an instant, then developed. This negative will be clear ex-cept for the dark border lines. The negative is used in the same manner as the one first described .- W. TRUETT ROUSE.

Shallow holes and dents in either wood or metal can be filled more easily with a plastic wood composition if the spots are first coated with lacquer and allowed to become tacky .-R. D. Y.

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RUBBER RIM PROTECTS ROUND OILSTONE

SMALL, round, bench oilstones, alpurposes, would be more popular if they were not so easily dropped and broken. It is a simple matter to prevent this. Merely snap a soft rubber fruit-jar-cover remover around the stone as shown above. This does not interfere with most jobs of point or edge dressing, and even if the stone is dropped on a concrete floor it is not likely to break. The rubber also makes it easier for the fingers to grip the stone.—FRANK W. BENTLEY, JR.

RIVET PRESS FOR RELINING BRAKES

WITH this practical, homemade rivet press it is a simple matter to punch out the old rivets and install a new set of brake linings. The press is surprisingly powerful.

The photograph so clearly shows the arrangement of the various parts that little need be added. Any practical man can build such a press in a few hours of spare time at practically no expense.

The foot lever is a piece of 2-in, pipe flattened at one end and slotted at the other to receive the upright plunger, which passes through a suitable hole in the bench top. The upright is likewise a piece of pipe, 34 in. in size, treated in a similar manner. The top lever is a straight piece of bar stock 11/2 by 3/8 in. with three holes drilled through it.

The plunger is one of the original steering spindle bolts turned upside down and slotted at the upper end to receive the forward end of the upper lever. Since this pin is hardened, the slot will have to be ground in with a thin wheel or the end of the pin will have to be annealed and the slot sawed with a hack saw and drilled for the pin.

Simple dies for punching out old rivets and expanding the ends of the new ones may be filed or ground from suitable bolts of a size to fit the threads in the lower



Made from scrap parts in a few hours' time, this press does the work of an expensive one

end of the spindle (the hole formerly occupied by the oil cup or grease-gun coupling) and casehardened; or such dies may be purchased readymade at small expense from auto supply houses.

The upright brace or fulcrum for supporting the top lever is a piece of ordi-nary bar stock 3/4 by 3/16 in. bolted to the axle through a suitable hole bored through that member.

A U-bolt through the top of the bench at the base of the fork in the axle, together with a couple of bolts through the spring perch where the axle was sawed off, will serve to hold the device solidly to the bench.

An ordinary valve spring (not shown in the photograph) threaded on the spindle bolt between the top lever and the top of the axle fork serves to cushion the thrust when old rivets are being punched out.—R. G. B.



FINGER GRIPS FOR THIN METAL PROTRACTORS

THE small, light, and inexpensive metal protractors used so commonly in school work in connection with geometry and for amateur drafting are difficult to handle and move over the paper. The fingers cannot easily grip them, and as a result they are often rubbed over the work in such a way as to smudge the lines. To remedy this, make cuts in two places on the protractor as shown and bend up the edge between to right angles. slight projections give a good grip for the fingers.-B. W. F

CEMENTING SANDPAPER TO METAL DISK

Various adhesives are used by amateur craftsmen to attach sanding disks to the metal plates that are now so commonly used for disk-sanding operations. Among them are shellac, collodion, glue, and

For attaching garnet paper or other abrasives to a metal sanding disk, a hot mixture of rosin and castor oil makes a good adhesive

plastic metal cements of different types. I tried them all without entirely satisfactory results, and then discovered that a mixture of rosin and castor oil would do the trick. The rosin is melted in a

tin can, and about one third of its volume of castor oil is stirred into it. The metal disk is warmed over a flame for half a minute or so if it is cold, and the mixture is smeared over it. The disk of garnet paper or other abrasive is applied immediately, and the whole is set face down on the floor and weighted. The disk is ready for use as soon as it has cooled. It will stand up under exceptional use.-R. W.

TIN-CAN DIPPERS AID IN PAINTING

For handling gummy or sticky liquids such as paints and oils, a serviceable dipper can be made from a No. 2 or 21/2 tin can in a moment's time with a pair of tin snips. Such a dipper is more convenient to use than an empty can just as it comes from the kitchen, and it saves soiling the fingers and avoids wasting material, Besides, it can be thrown away after use, since it is easier to make a new dipper than clean an old one. Cut the top of the can off at an angle and fasten it with two nails to a broomstick handle about 12 in, long as shown in the accompanying photograph,-E. D. HAY.



This type of dipper is so easily made that

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STEEL BRIDGE FOR MODEL RAILWAY

ALTHOUGH it may seem rather complicated, this steel bridge is not difficult for a model maker to build for his notel railway, and it is more modern than the pile trestle described last month (P.S.M., Apr. '34, p. 98). It may, of course, be simplified to any extent, but for the time being we shall assume that metal is to be used.

Brass, being easy to handle, will probably he the most suitable. It can be purchased in strips of any desired width and is easily soldered or drilled. If you are building to a scale property of the strip of the strip of the progiven on the plans may be reduced to actual size by dividing by three, the result being the size of the member in sixteenths of an inch. Take, to example, the end post 4 in Figs. 3 and dividich is blowned to the first sons by three and using the nearest sixteenth, the 25-in, plate works out to be 8/16 or ½ in, wide, and the two webs 7/16 in, wide. The vertical member E would be hult up for the center web. The bottom chords C would be of ½-in, strips tied with plates ¼ in, wide,

The original plans for this bridge showed the bridge ties supported by 48-in, fabricated I-beams. As shown in Fig. 4, timber stringers have been substituted for these I-beams. They are inconspicious, and the ties can be fastened directly to the stringers with brads. Figure 5 is a typical sectional view taken at the intersection of memhers C, E, F, and K, showing their arrangement on the connecting pin. Note that there are four eyebars K

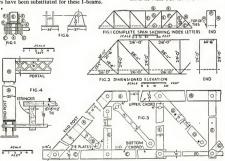
between each of the two center spans.

The bearing shoes, of which there are four, are made up of heavier material and are shown in detail in Fig. 6.

For those who desire simpler construction, Fig. 7 shows the truss as it would appear if cut from one solid piece of plywood or some similar material. In this case the eyebars have heen omitted and square structural members substituted

Figure 1 is a key giving the index letters that have heen used in the other drawings, and Fig. 2 shows full-size dimensions taken from center to center of the various structural parts of the hridge.—J. W. CLEMENT.





Details of a single-span steel truss with actual dimensions so that a model maker can build an accurate model to any scale. The upper drawing (Fig. 7) shows a simplified construction



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MOUNTING CROSS HAIRS MADE OF SPIDER WEB

CROSS hairs of some description are an essential part of such optical instruments as transits and finder telescopes when it is necessary to locate some object accurately within the field of view. The finest of



How a bow-shaped piece of wire is used to set cross hairs over a telescope diaphragm

all cross hairs are those made from spider web, and when the correct methods are used, they are easy to install.

A cell or diaphragm of thin metal or cardboard is required to carry the cross hairs. It should be just large enough to fit snugly within the tube of the instrument, and the center hole should be but slightly larger than that of the regular diaphragm. After accurate the control of the control of the control is the control of the control of the control is the control of the control of the control of the projecting support, as shown.

A small U-shaped bow is made from a piece of fine, stiff wire such as a wire violin string, and a tiny bit of wax or chewing gum is affixed to either end. A suitable strand of uniform thickness from the radial lines or brace lines of a spider web is now located and secured to the bow with a couple of turns about each waxe of the spide of the

and secure to the now with a couple of turns about each waxed end.

The web should now be laid directly across the center of the diaphragm. The weight of the suspended how serves to stretch the web tightly. Secure the web at stretch the web tightly, Secure the web at which the stretch the web give the stretch the web give the diaphragm a quarter turn, and repeat the process with the second strand.

The entire cell should be carefully pushed into the tube or eyepiece of the instrument to the position which gives the cross hairs the most perfect focus. Applying a few drops of glue will serve to keep it permanently in position.—L. C. PELTER.



Two strands of spider web set in a telescope finder. They are the best of all cross hairs

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STRANGE PLANTS YOU CAN SEE IN YOUR MICROSCOPE GARDEN

(Continued from page 43)

gentle flame if necessary. If your bacteria have gentie name in necessary. If your bacteria nave been distributed on the cover glass, pass it two or three times through the gas flame, bacteria side up. This "fixes" the tiny plants. If they are on a slide, you can pass it through the flame a half-dozen times. A still better way is to place a few drops of ninety-five percent alcohol on the specimen, let the excess drain off or remove it with a blotter, and then touch a match to the remaining alcohol film while the slide is held with the bacteria-covered side uppermost. Let it burn itself away.

To stain the bacteria, place a few drops of water on the fixed specimens, and add a drop of Loeffler's methylene blue or other stain. Let it act several minutes, then wash off with clear water and dry. Fasten the cover glass to

the slide with balsam

OU can spend a thrilling evening looking Y at the molds that spring up like weeds in your dust garden. You can observe them in their natural states, or color them with various stains. Molds have been discussed in previous articles of this series, (P.S.M. Oct., '33

When handling bacteria and molds with the dissecting needle, you can make sure that particles from one specimen do not become mixed with those of another by heating the needle to redness in a flame, after each transfer. This action sterilizes the needle perfectly.

There are other types of micro gardens that you can establish. The growing of yeast plants is simple, and the plants themselves form one of nature's most interesting wonders. Your veast garden will consist of a small tumbler half full of a liquid medium made by diluting molasses with about six times its volume of water. Into this soil crush a single tablet of brewer's yeast or a piece of yeast cake the size of an aspirin tablet. Growth starts almost at once, and you can obtain specimens within a few hours. Simply remove a drop from the cloudy part of the liquid and place it on a slide, dropping a cover glass over it. At 300 or so diameters you can see the tiny plants. You can stain them with dilute tincture of iodine.

A single cell of brewer's yeast is round or oval in shape, with the nucleus plainly visible. It reproduces by budding, the buds projecting out from the parent cell like a grotesque nose. Often the tiny plants will cling together to form a chain or branched group. Some yeast plants take the forms of a club having a knob at one end. If you watch closely, or make repeated observations over a short period, you can see one of the most interesting things in the microscopic world-a single cell growing and dividing into two. Notice particularly how the nucleus behaves.

A YEAST plant, in growing, converts the sugar that is its food into alcohol and carbon dioxide. That action is the basis of a great industry, the manufacture of alcoholic beverages. You can trap the carbon dioxide by inverting, in the molasses and yeast mix-ture, a test tube that has been filled with some of the same mixture. Arrange the tube so that it will remain upside down for several days. At the end of that time, you will have collected a little pocket of gas at the top of the liquid column. A match plunged into this gas goes out at once because the "C-O-2" will not support combustion.

If you search carefully through the remains of a rotted log in the woods, and perhaps dig into the ground a bit, you may find more tiny wonders of the plant world. Some are little fungus plants with minute knobs and cups, each plant hardly larger than the end of a common pin. Then you may discover some other wee plants, real plants with tiny leaves and stalks that will provide you with abund-ant material for observation. Take home some of the rotted wood and surrounding soil, together with the plant samples, and establish a garden in a clean petri dish or any other suitable covered container. Keep the soil moist and warm, and your miniature plants will thrive for a long time.

Micro gardens play a highly important part in the lives of millions of persons. Physicians, hospitals, and research workers use methods similar to those just outlined for growing bacteria for study, for identifying disease, or for watching the effectiveness of treatment of

an infection or contagious disease. How big is a yeast plant?

PERHAPS a question like that has occurred I to you more than once as you gazed at some microscopic treasure. You can answer it with fair accuracy by a simple measuring method.

Arrange your microscope so that you can see an image of the specimen as if it were projected on a white sheet of paper. You can do this by gazing into the eyepiece with . ne eye and at a sheet of blank paper with the other. If you find it difficult to arrange the paper so that the microscope stage does not nterfere, tilt the instrument so that the tube is horizontal, and use a mirror set at a forty-five degree angle, (P.S.M., Apr. '33, p. 49); or another attachment that will be described presently.

In order to make a reliable measurement the distance from your eye to the paper should be the same as the distance from your eye to the microscope stage or a point slightly below. For a standard microscope of the better class, this distance is approximately ten inches. actually is the distance from the eye to the image of the specimen formed by the system of lenses. When the image is projected clearly on the paper, mark with a pencil the points between which you wish to measure, or use dividers. You may have a little difficulty balancing the illumination on the paper and on the object.

Now measure the distance between the pencil points, and divide it by the number of times the object was magnified. It is assumed. of course, that you know the power of your microscope. For example, if a diatom image proved to be three-quarter inch long when projected against the paper, and the micro-scope was magnifying 450 diameters, the ac-tual length would be three-fourths divided by 450, or 1/600 inch.

A SIMPLE little device that is useful in making drawings or measurements consists of a very thin, square cover glass mounted at an angle of forty-five degrees to the eyepiece. The microscope is placed in a horizontal position, and the eye is held so that it is very nea the center of the glass, on the side nearer the lens. Rays from the eyepiece are reflected into the eye, so that they seem to come from the paper that can be seen through the cover glass.

Still another way of measuring the size of an image or, if the size of the original specimen is known, the magnifying power of the instrument, is to project the image on a ground glass set at the proper distance from the eye piece. Also, the image can be projected on a white card if little or no extraneous light eaches the card. An arc lamp or high-intensity Mazda lamp is useful for illuminating the specimen, when such projection systems are used.

Cleaning glass slides, cover glasses, and other glassware used in the microscope laboratory sometimes presents a problem. Several clean-ing solutions (Continued on page 105)



on one with any sterroscope.

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PLANTS YOU CAN SEE IN MICROSCOPE GARDEN

(Continued from page 104)

have been recommended. A widely used laboratory preparation is made hy mixing one ounce of commercial sulphuric acid and one ounce of potassium hichromate with ten ounces of water. This preparation will remove grease and halsam from slides. It has one bad point: it is hard on fingers, clothing, and other things.

If you have started a collection of color filters for visual observation and photomicro-graphy, you will he wise to standardize them as to size, say two hy two inches and then build a box in which to keep them. A filter hox made from walnut is illustrated. It consists of a main portion whose longest sides are grooved to receive the glass squares, much like a standard microscope slide file. The lid fits into a rabheted groove at the top of the box, the rahbet making a fairly dustproof joint. The corner joints of the box and lid can be made in any standard manner. The best appearance is produced by miter joints that go together like the corners of a picture frame. Small brass hinges and a ten-cent catch complete the filter hox. With the dimensions given, there is plenty of room for the lid to clear filters two inches square.

HE best way to make filters is to mount regular filter gelatin hetween pieces of glass and bind the edges with tape. In doing this, always glue, at one corner and on the inside surface of one of the pieces of glass, a little piece of paper hearing the filter number or letter. Arrange the filters in the hox in alphabetical or numerical order. Identifying figures or letters corresponding to those on the filter can he marked along the inside of the lid opposite the appropriate slots so that your filter can be readily selected without the danger of mistakes.

Here are a few biological stain formulas that you will find useful. If you do not want to mix them yourself, your druggist will do it; or he may have the solutions already in stock which will enable you to procure them at slight cost without going to the trouble of

making them for yourself.

Loeffler's Methylene Blue solution:
Methylene blue 0.5 gram.

Alcohol 95%, 30.0 cc.

Potassium hydroxide 1/10 normal sol, 2.0 cc.

Distilled water 98.0 cc. Dissolve the methylene blue in alcohol, then add the potassium hydroxide solution and the water. Another way of mixing the same preparation is to dissolve all of the methylene blue

possible in thirty cubic centimeters of alcohol, add two drops of a ten percent solution of potassium hydroxide to 100 cubic centimeters of water, and mix. Delafield haematoxylin: This is a standard

stain for animal tissues, etc.

Haematoxylin 1.0 gram. Alcohol (95%) 6.0 cc. Saturated solution of ammonia alum 100.0

Glycerin 25.0 cc. Methyl alcohol 25.0 cc. For use, dilute ten to fifteen times with

N PREPARING, proceed as follows: Mix the haematoxylin and alcohol and add the ammonia alum solution. Expose to light for a when the color will turn to a deep purplish hue. Then add the glycerin and methyl alcohol, and let stand two more days. Filter through paper. This is a stock solution that is diluted before use. When sediment

forms, filter.

Eosin: This stain can be used in the form of a weak solution in alcohol or water. It colors bacteria and animal tissue red, and is generally useful for staining plant specimens.





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HE "CASHED IN" ON LOCAL CONDITIONS

FOUR years of mine was earning a very comfortable living by making candy for known stores in the city. He had a steady position in congenial work, and the outlook seemed good. But



then the depression came, and he went through the same reverses that millions of other men have had.

The company that he was working for was one of the first to fail. He lost his job, and during all the long years of the depression he was forced to struggle for a living. He found it especially difficult because he had been in a luxury business. But, like the western piano tuner who makes a living by tightening barbed wire fences, he was able to adapt himself to the changing conditions. He could still make candy; the problem, then, was to market it

My friend's home is about midway between two high schools. He knew that after school many students buy candy or ice cream at the first store that they come to. If he could get to them first, the rest would be easy. So he started making candy at home, with his wife helping him. Then he purchased two small, portable stands which hold enough candy for a day's business and can be placed on the sidewalk or in any other convenient location.

Since then on every school day the two each load a stand with candy, take along some ice cream bars packed in dry ice. and then they separate, each going to one of the schools.

ON THEIR first day, when the students came out at the close of school, they found my friends right outside the entrance with all the popular candy and ice cream bars as well as their own home-made candy. Naturally enough they bought readily, feeling that they might as well buy there as any place else. Thus was started a small but thriving trade. Other students who normally remain after school for the various school activities and can not take time to go to a store for candy have become customers. A Model-T Ford, which is inexpensive and economical to operate, furnishes their transportation between the high schools.

They have added to their trade by making extra candy and selling it at their home. During the holidays they make special Christmas candy. They advertise weekly in the (Continued on page 107)

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Secrets of Success

HE "CASHED IN" ON LOCAL CONDITIONS

(Continued from base 106)

school newspapers and have handbills printed for special occasions.

My friend is not making a fortune, but he is making enough to support his family and tide them over the depression. The idea has its drawbacks, for schools are open for less than two hundred days a year. Perhaps when better times come he will be able to get a regular position, but in the meantime his ingenuity is making him a living and is keeping him independent.-R. F., Cincinnati, Ohio.

FROM TEXT-BOOKS TO TOMATO JUICE



N JUNE, 1931, Snead and Snead came home from college after finishing their sophomore year and began looking around for a va-cation job. Home was Evanston, Illinois. Snead and Snead was a part-nership dating back

to high school days; the partners were Thornton, Jr., and Walter, twins; and the nature of the business had been anything from mowing lawns to selling Michigan fruit to Evanstonians. That year prospects did not look very bright.

One day, while in their mother's kitchen, they watched her making tomato juice from whole, ripe tomatoes that seemed to taste much better than the popular brands then on the market. Investigation and experimentation followed. They discovered that the tomato juice put up by most packers was really nothing more than a by-product. An idea was born. Why not use whole tomatoes, with all the rich pulp and juice combined, to make a delicious, health-giving beverage?

Snead and Snead wasted no time in getting started. They began working on fancy, ripe tomatoes from an Indiana tomato farm and soon had their product ready for the market. Morning Glory Tomato Juice, it was called. They distributed samples among their friends and neighbors in Evanston, and the unusual qualities of Morning Glory began selling itself.

Within three months from the time they bottled the first jug of the finished tomato juice, Snead and Snead moved from mother's kitchen to a small plant of their own. The infant industry had expanded much more rapidly than they had dared hope.

(Continued on page 108) As their

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Secrets of Success

FROM TEXT-BOOKS TO TOMATO JUICE

(Continued from page 107)

product was different, so was their method of distribution. Morning Glory was placed in the refrigerators of the socially prominent families and the clubs and restaurants in and around Evanston. This was done through representatives who may be termed "socialites"—first locally, and later in the principal cities throughout the United States. They also employed the services of a few students, who introduced the product to colleges, universities, and various public institutions. There was no extensive advertising campaign. which would have meant unlimited expense, but a dignified selling system that was just as effective in putting the product across to the public.

In their plant the Snead boys now employ five persons with two truck drivers. in addition, for deliveries to freight stations and nearby points. Morning Glory representatives now number 168, besides the so-called "college group," which has

grown from 15 to 200.

On January 1, 1934, having been in business less than three years, Snead and Snead was incorporated. As a confirmation of the success of their policy and the superior quality of their product, they point with pride to the list of stockhold-ers, directors, and the extensive list of customers, which includes not only prominent individuals but schools, hospitals, clubs, hotels, and railroads in all parts of the United States .- J. C. J., Chicago, Ill.

Cash Prizes

THIS department will give \$5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine,

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address con-tributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.



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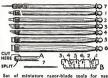
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RAZOR-BLADE TOOLS AID IN DELICATE CARVING

For delicate patterns on small ship models, for intricate inlays on small toilet articles and make-up boxes, and for small overlay initials and similar hand carving. I use a set of tools made from old razor blades. A pair of wide, blunt-nosed pliers will serve for breaking the blade. Be careful to have the sides taper so that they are a trifle narrower at the blade edge than at the handle, as shown at B. This is done so that when the wire is tightened around the handle, it will

hold the blade securely.

The handles are whittled from cigar-box wood. After they have been roughed out, I



Set of miniature razor-blade tools for use when regular carving tools would be too big

make a cut across the handle, about 1/4 in. from the blade end, and split the wood up to this cut, as shown at A. This split part is carefully sanded, the blade glued in (for convenience in handling), and the split piece put back into place. The entire end is then tightly bound with No. 22 gage enamel-covered wire. After the blade is in place, the handle may be trimmed, sanded, and enammanuer may be trimmed, sanded, and enami-eled, lacquered, or finished in any manner. Tools Nos. 1, 2, 3, and 4 are for use on small carvings; Nos. 5 and 6 are used for cutting balsa wood to be used in airplane modeling, and No. 7 is a medium-sized needle for scribing and for use as a scratch point.

A 2-or 3-in. strip from an old razor strop, glued to a block of wood, serves to keep the blades in condition. A neat and convenient container for these tools was made from cigar box wood and patterned after the puzzle box illustrated in a previous issi (P.S.M., Nov. '32, p. 104).—E. P. HALE.

WATER GLASS HAS MANY USES IN THE SHOP

ALTHOUGH water glass (chemically, a solu-tion of sodium silicate) is most commonly associated with the preservation of eggs, it is a cheap and useful material for many home workshop purposes. Used as a glue, home workshop purposes. Used as a glue, it will fasten cardboard parts quickly and securely. It gives a glasslike protection to bottle labels to which it is applied. Photo-graphs may be mounted quickly without wrinkles and are actually reënforced by this material. If it is applied in a thin film with a roller to the face of a dull photograph, it will impart a high gloss and dry in five seconds. Rubbed with a cloth into the surface of unfinished wood, it brings out the grain and at the same time acts as a quickdrying filler to which shellac or varnish can be applied immediately. It holds flat wood surfaces together tenaciously. When mixed with plaster for casts, it gives the latter a close grain and sheen that improve their appearance. A water glass and plaster mixture is also handy for temporarily recementing light bulbs that have come loose from their screw bases. A drop mixed with printing ink on the rollers of a card printing press will improve the quality of the work in some instances and hasten the time required for drying.-G. S. G.

"I have a hunch . . !"

Gentlemen:

Under the Recovery Act I'm now working less time and I have decided to devote a regular portion of my spare time to making myself more valuable to the company. I have a hunch the man who gets ahead tomorrow will use his head today.

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REDUCING HOLE IN WORN BLOWTORCH BURNER

WHEN a blowtorch burner goes bad, the first aid it usually gets is an attempt to clean out the jet with a needle. After a few such treatments, the iet is enlarged, more gas comes through than can be properly vaporized, the flame turns yellow, and the burner is discarded as worn out.

On most burners, the jet can be reached with a simple swaging tool that will reduce the enlarged hole and make the torch burn like new. The work, including the making of the swage, is not difficult, and the result is well worth the trouble.

A center punch ground to a sharp 60deg. point and a 4-in. length of 3/8-in. tool steel are required. With the steel upright in a vise, heat the end and make a punch mark in the center deep enough to be 1/8 in. in diameter. Chuck the piece in a lathe with

DISPLICE.

How tool is centered

OHNCH

NEFDLE .

OF P

the punch mark on the tail center, and taper the end at about 30 deg. down to the punch mark, leaving a sharp edge. Harden and draw to a brown, and smooth the edge on an oilstone This outside tapering can be easily done on an emery wheel if a lathe is not avail-able. The sketch. able

over the enlarged jet which is almost full size, shows a section of the swage and the work it does-that is, how it draws together the metal around the tiny hole in the burner

of the blowtorch. Set the burner in a vise and start the swage with a guiding needle inserted through the channel occupied by the regular needle valve and through the jet. The hollow point of the swage, pressed against the guide wire, is brought accurately against the face of the jet by backing out the guide. To make the guide, select a straight sewing needle that is a good fit in the jet to be closed. Break off the eye and mount the sharp end in a round piece of wood loosely fitting the in a round piece of wood nosely fitting the needle-valve channel. With the swage in position, strike a very light blow and see if the mark encircles the jet accurately; if it does, continue striking lightly, turning the swage between strokes, until a groove is formed around the hole and the inner cone of the swage has drawn in the edges of the jet the swage has drawn in the edges of the jet to the proper size. While the swaging is progressing, the hole must be kept truly round and straight with the burner by burnishing frequently from both sides with a darning needle set in a small handle and used as an awl.

used as an awr.

It is quite essential to the proper working
of the burner that, when tested, the jet
should throw a smooth, solid stream of
gasoline straight through the center of the burner and several feet beyond. Be sure to lubricate the burnishing needle and work with a gentle hand.

In assembling the burner, use a paste of soap and graphite on the threaded joints. Be sure there is a free flow of gasoline through the wire gauze wick usually found in the tube between tank and burner. See that all carbon is bored out of the passages that all carbon is bored out of the passages in the burner with the appropriate size twist drill. The point of the needle valve should be trued up and made very smooth. The last thing is to wash out the debris from these various operations and make sure again that the jet will throw a straight, solid stream of gasoline. The proper size for the jet can be found only by experiment as it varies in burners made by different manufacturers.-MAX CHARLES PRICE.

HOW UNCLE SAM'S SCIENTIFIC DETEC-TIVES SMASH KIDNAP GANGS

(Continued from page 17)

tapping apparatus failed to record the number being dialed. Thus, a detective would hear the conversation but miss the all-important information of the number being called. The new apparatus automatically records the number as well as the conversation.

The department also bas the largest fingerprint file in the world. Nearly 5,000,000 malefactors are classified according to the dis-tinguishing loops and whorls of the ridges on their fingers. In addition, there is a kidnaper's "Four Hundred," a selected group of prints representing known abductors and extortionists. This file holds 2,800 prints, the classifica-tions being made on single fingerprints instead of on the basis of the ridge pattern of all ten fingers.

IN ONE case, a kidnaper went over the outside of an envelope after he had sealed it and removed every latent fingerprint. But, unknown to him, a single perfect print had been left in the softened gum under the flap. It was discovered by Federal detectives in the laboratory and helped convict the sender of the note

A curious use of fingerprints in pinning

evidence on a gang of snatchers figured in the famous Boettcher Case of Colorado. Late on the night of February 12, 1933, a Denver, Colo., broker, Charles Boettcher, II, turned into his driveway. Leaving his wife at carned into his driveway. Leaving his wife at the wheel, he got out to open the garage doors. As he snapped on the lights, a man stepped from behind the machine with drawn pistol. "Stick 'em up!" he commanded, "This is a holdup."

Ordering Boettcher into a small dark-colored car, he left him guarded by a confederate and returned to Mrs. Boettcher, handing her a large envelope from which he ordered her to take a smaller one giving him back the outer envelope which contained his fingerprints. A moment later, the dark machine shot out of the driveway into the street. The note which had been left behind demanded S60 000 ransom

Communicating with the abductors by tossing notes over a culvert on a rural road some distance from Denver, the father of the kidnaped man paid the ransom and on March 1, the captive was freed not far from his home. He related how his eyes were taped shut, how the car was driven around several blocks and then was headed in one direction on a run that lasted the rest of that night and all the next day. When it stopped, he was required to walk up twenty steps and then down some stairs again and into a basement.

LIKE Urschel, he kept his senses working, counting footsteps, estimating distances, listening for sounds that might tell him where he was. Also, unobserved, he put his fingerprints all over the room, under tables and chairs where they were not likely to be removed. And, later on, when clever detective work led the Federal investigators to the South Dakota ranch of the outlaw, Verne Sankey, the discovery of these fingerprints offered proof positive that it had been the bideout of the gang.

While awaiting trial in a Chicago cell, Sankey committed suicide, hanging himself with his necktie.

While the Lindbergh Law was passing through the House and Senate, the ace detectives of the Department of Justice, were being called to Washington in small groups. For weeks, they were given intensive training to fit them for their new work. Curious courses sharpened their wits and helped them outsmart the abduction gangs.

They studied footprints and broken glass, inks, and tiremarks, papers and bullets. They

worked with ultra-violet lamps and comparison microscopes. At Fort Meade, Md., they underwent advanced instruction in the use of firearms and gas guns. Only three "G men," as government sleuths are known in the underworld, have been killed since 1908. The implacable man hunt which followed each case has impressed the idea that escape is impossible for the murderer of a detective of the Department of Justice. Every one of the 350 operatives in the serv-

ice is a graduate lawyer with the exception of the men who work on bank cases. They are expert accountants. Rhodes scholars and graduates from almost every university in the country make up the force. It is the cream of the law enforcement army of the nation.

The country is divided into twenty-five sections with a field officer and a group of special agents under him in each division. There is no working at cross purposes. Each group, in constant telegraphic touch with Washington, covers its own territory so a minimum of time is lost in travel. Some months, as many as 15,000 cases, no two alike, are investigated by these hard-riding govern-ment detectives. Trained to know the value of evidence, they are able to present such airtight testimony to juries that, Hoover told me, they have established the almost unbelievable record of ninety-five percent convictions in all cases that come to trial!

IN THE Luer kidnaping case of Illinois, when the "Dice Box Kid" and his gang abducted the seventy-seven-year-old Alton banker, August Luer, and kept him for days in a tiny underground room, the Federal agents cleaned up the crime and saw six members of the gang on their way to the penitentiary, three for life, in less than sixty days.

To help in abduction and extortion cases, the laboratory of the Washington crime hawks includes the largest collection of papers and watermarks in the country. Nearly 25,000 kinds of paper is on file and as each new watermark is registered at the U. S. Patent watermark is registered at the U. S. Patent Office, a copy is added to the collection at the Department of Justice laboratory. Inks and specimens of typing from practically every known make of typewriter are also stored away for ready reference. Last fall, when a typed note reached Dr. Albert Fritz, New York physician, threaten-

ing harm to his children unless he paid \$10,-000 to the writer, this reference collection enabled an expert of the crime laboratory to report almost immediately that the note had been written on a dial typewriter of the sort used by children.

A check of all the doctor's patients revealed A check of an the doctor's patients revealed that one, John Isola, had a criminal record. He roomed with a family including a small boy who owned a dial typewriter. The boy's mother remembered that Isola had once borrowed the machine. A comparison in the laboratory proved that the threatening letter had been written on it. Isola went to prison for ten years.

ANOTHER valuable aid in the work of Federal sleuths is a collection of blueprints showing the treads of practically every known make of tire. When "Taters" Ray-mond and his accomplices abducted George N. Davis, a retired industrialist of Lewisburg, W. Va., last year, holding him for \$10,000 ransom, the tire prints of the car they used formed an important clue in the early stages of the investigation. In the DeJute kidnaping in Ohio, the fact that tire marks showed that the wheels of an automobile had been spinning in a hasty getaway figured as a link in the chain of evidence which sent three men to prison. (Continued on page 112)

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HOW DETECTIVES SMASH KIDNAP GANGS

(Continued from page 111)

Small clues are probably more important in trailing snatchers than in almost any other crime. In kidnaping, there is no bullet, no bloodstains, no body, as there is to help the sleuth unravel a murder mystery.

In one instance, a boy abducted in an eastern city, could give no idea of where he had been held. The only thing he could remember was that from a small window he saw boys playing around a khaki pup tent in a vacant lot. Running down that slender clue, detectives checked off every vacant lot in the city, found one where boys had had a tent, canvassed the neighborhood, discovered the room where the boy had been held captive, gained a description of the two men who had rented it, and ran the kidnapers to earth.

NOT long after the mysterious death of Smith Reynolds, young tobacco heir, his two-year-old daughter by a first wife was threatened with kidnaping. The child's grandfather, Joseph F. Cannon, a wealthy mill owner, received letters signed "THE FOUR MUSKETEERS." They directed him to leave \$20,000 on the upper shelf of a china closet in a vacant house at Hapesville, Georgia.

Government men sped to Hapesville. They went over the territory and, working at night with flashlights taped so they gave forth only tiny needles of illumination, they installed electrical apparatus which would enable them to follow, from a distance, the movements of anyone entering the house and would give an alarm if the ransom package was disturbed. Floodlights stood ready to flare up at the throw of a switch. A high-powered car, manned by two of the agents, stood in a garage near the vacant dwelling and a small army of police, armed with sawed-off shotguns, revolvers, and automatics, was standing by for the signal.

With the trap thus set, an advertisement was inserted, as directed, in a local paper and the money was left in place. For three days and three nights, the men kept vigil, one Federal sleuth on a rooftop scanning the sky with powerful binoculars and noting down the number of every passing plane, another jotting down the licenses of all automobiles driving through the neighborhood.

ON THE fourth day, a well-dressed young woman strolled up to the vacant house and entered. Their electrical apparatus told the waiting agents what she was doing. She pulled out the lower drawer of the china closet, stood on it and took down the package containing the money. Arrested before she could leave the house, she said she was Mrs. Sue Boyles, wife of a parachute rigger at a nearby airport. She maintained she was simply carrying out a request to get the package for her husband and had no idea what it contained. Boyles was taken into custody. He was fingerprinted and found to be an ex-convict. Evidence pinned "The Four Musketeers" plot to him and he went to the penitentiary to

serve a fifteen-year sentence. Time and again in their spectacular work of smashing kidnap gangs, the Federal agents have turned to the aid of apparatus and the laboratory. The results they have obtained is a triumph alike for the skill of the government men and for the effectiveness of clues unearthed by science.

HOW THE SUN AND MOON ARE ECLIPSED.

(Continued from base 51)

umbra. The gray shadow ring surrounding the umbra is the penumbra.

An observer at any point on the earth's surface within the umbra will see the sun totally

obscured. At any point within the penumbra, the eclipse will be partial.

To test the truth of this, make two holes through the card representing the surface of the earth in the illustration. Make one any-

where in the umbra. Make the other anywhere within the penumbra. Then place the eye at each in turn. When obscures the lamp, as shown in the diagram

When the eye is at the other hole, the golf ball only partially eclipses the lamp bulb. One of the diagrams also shows how the rays of light from the sun criss-cross around the moon and enclose the long narrow cone of shadow which produces a total eclipse when its end is cut by the earth's surface.

F THE moon revolved around the earth in exactly the same plane in which the earth travels around the sun, total eclipses of the sun would not be as rare events as they are. In fact there would be some kind of a solar eclipse every month. The reason total solar eclipses are rare is due to the fact that the plane of the moon's orbit slants slightly to the plane of the earth's.

There are also two other interesting conditions which modify the occurrence and character of solar eclipses. They can both be covered by the statement that the orbits of both sun and moon are not perfect circles, but extremely short or fat ellipses. And neither sun nor earth is at the center of the ellipse, but considerably to one side of the center.

In the case of the earth's orbit, the offcenter position of the sun causes a decided variation in the length of the shadow cone, or

umbra, cast into space by the moon. The average length is 232,000 miles. Let us see how the length of the cone varies when the earth changes its position in its orbit.

For example, when the earth is nearest the

sun, the length of the moon's shadow is onesixtieth less than the average. And when the year has advanced until the earth is farthest from the sun, the shadow cone will be onesixtieth longer than the mean length. You can see that this would make considerable difference in the width of the path of totality and the length of time totality lasts.

THE result of the off-center position of the earth in the moon's orbit leads to an entirely different result. If an eclipse occurs when the moon is at a node nearest the earth, the eclipse will be total. Why? Because the moon is slightly nearer us and obscures the sun completely.

But if an eclipse occurs with the moon at a node farthest from the earth, the eclipse will be "annular," In other words, the moon, be-In other words, the moon, being farther away, and smaller, will leave a ring of the sun's disk showing around the black disk of the moon.

So far we have considered only eclipses of the sun. These necessarily occur at new moon, but lunar eclipses happen only when the moon is at full.

Eclipses of the moon are not spectacular, and are slow-moving, for the moon sometimes takes four hours to pass through the earth's shadow-cone, which is about 5,700 miles in diameter at the point where the moon plunges through it.

Ever since about 800 RC there has been a period called the "saros," by which the return of eclipses can be roughly predicted. Solar and lunar eclipses can both be pre-

dicted by means of the saros, but only roughly as to the actual time and place.



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WHOLE WORLD NOW

(Continued from page 33)

up. It stuck out like a sore thumb in the otherwise primitive setting. So Shackelford covered it with palm bark, stuck on fresh leaves and turned it, to all appearances, into a coconut tree! Fish nets, hung around the trunk, hid the straight lines, adding to the illusion.

In filming "Four Frightened People," Cecil B. de Mille searched the Hawaiian jungles for a location until he found what he wanted at the bottom of a hidden canyon, 200 feet to make test shots. In some places, the undergrowth was so dense that men could walk safely ten feet above the ground. Players could not reach the location until a long stairway had been built; and cameras, batchute to the floor of the canyon. Wooden chute to the floor of the canyon.

THE generators which supplied the current for the work were left on the edge of the slope, half a mile away. The actors rested and changed costumes in flooriess dressing rooms brought in crates from Hollywood. Three men could set up one of these demonstrates the lowest result of the control of the control

anof was built into the front.

Three Seas up the side of the volcano, Marian and Season and Season

actions the scan against the scenes, camermen found from many of the scenes, camermen found it impossible to obtain soft color tones until they had created a screen of black gauze they have the scan against the

Metal reflectors now replace glass mirrors for concentrating light on out-of-door senses while they are being filmed. Forty of these nonbreakable reflectors accompanied de Mille to Hawaii. In the tangled bamboo jungles where many of the seense were shot, however, sunlight rarely penetrates. For that reason, the company carried twelve kinds of artificial lights to give some semblance of day to the perpetual gloom.

WHEN another company made an expedition to the tropics, all the filming was done at night. The heat and humidity of the daytime were thus avoided and hetter films were the result.

Many location trips to out-of-the-way places in America require special preparations, with equipment that can be easily transported and which is designed for particular conditions. In filming "Laughing Boy" in Arizon recently, the studio sbipped sound trucks by railroad to the town nearest the location. From bere, they continued under their own power. At the same time, the cameras and lighter equipment crossed

the desert from Los Angeles by motor truck. Every item carried on a film expedition to a distant part of the world must be reduced to its minimum weight. Recently a studio engineer designed a big electrical generator which can be broken down into four units of 300 pounds each. Sufficiently powerful to supply current for the sun arcs, which are used even along the equator, it can be transported to otherwise inaccessible recions by airplage.



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FACTS REVEALED BY HOUSEHOLD DRUGS

(Continued from base 57)

water. This can be shown by holding a burning strip of magnesium ribbon inside the open mouth of a flask or beaker of boiling water. The metal, held in the atmosphere of steam, will continue to burn.

To prove that the magnesium actually was burning in the steam, stealing the oxygen necessary for its combustion from the water, repeat the experiment using a lighted match instead of the burning magnesium. It the magnesium, it will be extinguished. Unlike

Magnesium can be made to combine with nitrogen as well as oxygen. The product of such a reaction, of course, will be magnesium nitride rather than magnesium oxide. perform such an experiment, the home chemist can take advantage of the nitrogen in the air by tightly packing some of the metal in a covered crucible and heating it for a half hour over a gas burner. When the fused mixture that results has cooled and is broken open the top portion or crust will prove to be white magnesium oxide. Beneath this, however, will be found a yellowish mass of magnesium nitride. To test the magnesium nitride, place a few drops of water on it. Ammonia gas, instantly recognizable because of its odor, will be given off.

LIKE most metals, magnesium can be made to alloy or combine with mercury to form magnesium amalgam. Unlike most common amalgams, however, it will start a curious reaction when dropped into water, decomposing the water to liberate hydrogen and form magnesium hydroxide.

The home chemist can prepare such an amalgam simply by cleaning a strip of mag-nesium ribbon with emery cloth and allowing it to remain in contact with a small globule of mercury for an hour or so. At the end of this time, the two metals will have become sufficiently alloyed to perform the experiment with the water.

MAGNESIUM amalgam also can be made quite readily from powdered magnesium. Simply place a drop or two of mercury in a mortar, add some magnesium powder or ribbon, and grind the powders into a fine mixture. Soon a sticky, pasty mass will be formed. This is a magnesium amalgam which, if left exposed for any length of time, will decompose the moisture in the air to form hydrogen and magnesium hydroxide.

Although most compounds of magnesium are white, the queer properties of magnesium chloride offer the home chemist a novel experiment in chemical colors. First, some magnesium chloride is melted in a crucible. an evaporating dish, or the shallow friction top of a tin can. The chemical will melt easily in its own water of crystallization. In this molten condition, it will dissolve

many different chemicals and metallic oxides to form beautifully colored molten masses. For instance, when tiny bits of cobalt sul-phate are added they will produce a soft blue tint. Nickel sulphate dropped into a fresh batch of the molten chloride will form a deep purple color. A small crystal of copper sul-phate will produce a brown. In each case, the color produced is a mixture of magnesia and the oxide of the metal used.

Magnesium chloride has another curious property that makes it an interesting substance from the home chemist's standpoint. When heated, it breaks down, decomposing to form magnesium oxide, hydrochloric acid, and water vapor (steam). The unmistakable odor of hydrochloric-acid gas will be evidence of the reaction and the fact that moist blue litmus paper will turn red will prove that an acid gas is being liberated.



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SAVING DOLLARS WHILE DRIVING YOUR CAR

(Continued from page 64)

"We won't bother about names-just fig-"We won't bother about names—just fig-ures," he suggested as he lifted out one of the cards. "For instance, here's a six-cylinder car, a 1930 model. During '31, the only repair was a carbon job. In '32, the brakes were adjusted, the clutch repaired, new exhaust valves installed, and a whole new set of spark plugs was put in. In '33, the car had a rebore job, new rings, new connecting rod bearings, and a new set of tires. So far this year, the car has been in here only once, and that was for a frozen radiator. All in all, the car has cost over two hundred and twenty-four dollars for repairs in four years."

"Phew!" exploded Walton, "Expensive car.

I'd say. Glad it isn't mine."

Without answering, Gus fingered through the cards again and selected another.

"NOW, here's the same make car, same model, but owned by another man. The mileages are just about the same on both. In 1931, he had a general check-up of the ignition system, carbureter, valves, and brakes in May and again in October, radiator flushed in April and November, and tires switched to in April and November, and tires switched to different wheels in December. During '32, chassis inspection, two general check-ups in the spring and fall, valves resurfaced and ad-justed, bearings tightened, and breaker points adjusted. Under '33, the usual two check-ups in spring and fall, two new tires, and new brake linings. So far in '34, the car hasn't been in.

"Gosh," broke in Walton when Gus had finished, "that second car was in here more than the first one.

"Right, but it didn't cost as much in the long run," said Gus. "All together, the three-year bill for that second car totalled only ninety-three dollars, including the tires. That owner believes in paying for prevention instead of cure. A check-up twice a year doesn't cost much and it keeps the general condition of the car up to par. It's cheaper to adjust bearings than to replace them.

"I've never looked at it that way." Walton admitted. "A repair shop to me has always been something to keep away from unless it was necessary. I don't know, but I've al-ways had an idea that some garagemen take

advantage of every chance to make money."

Gus smiled. "Some garages are that way," he agreed. "It's been claimed that car owners waste billions of dollars a year by dealing with gyp garages. That's why it pays to locate some honest service station and give it all your work. You wouldn't trust your life to a quack doctor, so why place your car's health in the bands of some crooked mechanic?"

ISN'T there some way an untrained person can tell if a garage is overcharging him?" inquired Walton.

"It would be pretty hard to make any fast rule on general work," Gus advised. "But with repairs, where parts have to be replaced, it's safe to figure about a dollar's worth of

labor for every sixty cent's worth of parts,"
"Well, in about four months I'll bring this
car of mine in and let you go over it," said
Walton as he climbed into the driver's seat. "Maybe there is something to this business of an ounce of prevention being worth a pound of cure.

"Weren't you just wasting your breath telling that fellow how to take care of his car?"

Joe Clark remarked as Walton drove off, "He never wants to spend any money unless be absolutely has to.

"It may help some," Gus said, and then added with a grin, "The Model Garage would have a tough time making ends meet if every customer on our list treated his car the way TRAVEL For "Uncle Sam"

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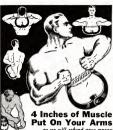
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PHANTOM RACE HORSE PRODUCED BY SCIENCE

(Continued from base 10)

this, the breeding and racing records of 10,-000 thoroughhreds in the United States, Canada, Great Britian, Australia, and other countries were systematically compiled. A folder was opened for each of these animals, and in it was filed its complete breeding and racing records. If the subject was a stallion, the names of all the mares by which he had produced offspring were listed, and the racing capacity of each of the foals noted. If a mare, each stallion by which she had pro-duced foals was listed, and the racing capacities of the foals noted

WITH all this information available, the racing record of each horse was anav r racing record of each norse was analyzed carefully. In determining racing capacity, only races truly run on good or fast tracks were considered. In fact, it was found that a truer picture of the borse's ability could he obtained if only the best of his races were considered, since nothing can make a race horse run faster than his racing capacity, but there are a number of things that, honestly or dishonestly, can slow him up. So if a horse had started in six or seven races that were truly run on good fast tracks, five of them were used in getting the mathematical picture of his racing ability. If he had run between thirteen and fifteen races, eight of them were considered. If he had run twenty or more races, ten of the races were used in computing ahility.

Using each borse's best races, bis "quality of performance" in each of them was found by comparing his average speed in each race with the seconds-per-furlong speed of the Standard Horse running under the same conditions of distance, age, and weight carried. If the horse under consideration ran the distance in time equaling the "par" established by the ghost horse, his quality of performance was rated 1.000. If be beat the Standard Horse's time, he was given propor-tionate points over 1.000. If his time was slower than the ghost horse's, his Q. P. rating

was proportionately under 1,000.

At the top of the list of scientifically rated

thoroughbreds stands the name of the hest borse of them all, Man o' War. This big red chestnut with the broad chest and the long back, a perfect specimen of a thoroughhred, has a Biological Handicap of 139.25 "pounds." In his two-season competitive career that included thirty-three minutes of actual racing, he won all but one of his twenty-one races. That one defeat by Upset was caused by a bad ride, and was revenged by three victories over the only horse that ever led him under the wire.

BUT, greatest of horses though he is, Man extreme consistency. The average quality of the nine best of his seventeen truly-run races is 1.0115. In his very best race he had a Q. P. rating of 1.0221, If he had been able to mainrating of 13221, 11 He had been also to maintain the level of that marvelous performance he would have had a Biological Handicap of 146.82, and, as Dr. Laughlin remarks, "no horse ever was that good." In his poorest truly run race on a good track, Man o' War earned a Q. P. of only .9545. If he never had bettered that performance he would have been a very mediocre race horse. Great as he was, Man o' War wasn't as great as the "im-ponderables" of horse racing. He wasn't always able to produce the best performances of which he was capable.

Two other horses are rated almost as high as Man o' War. One of them is Eclipse, who was foaled in England at the time of the great eclipse of 1764, and whose sons and daughters won 334 races. The other is St. Simon, another English thoroughbred of long ago. There is a dash of St. Simon blood in the veins of Man o' War.

When the thoroughbred is compared with other breeds of horses, its inherited racing capacity seems to be a remarkably uniform quality. But within the ranks of the thoroughbreds, now closed to all outside blood. racing capacity is far from being a uniform quality. To improve the breed, to produce race horses that can run faster and carry beavier weights for longer distances than the

beavier weights for longer distances than the best of our present-day race horses, there must be really scientific breeding. To provide an accurate guide for such hreeding, Dr. Laughlin has worked out a mathematical method of forecasting the probahle racing capacity of a foal of any stallion and mare. He calls it the Futurity Index.

Experience has proved that this Futurity Index will be more nearly accurate if it is calculated from the racing records of a group of the nearest direct and collateral blood kin of the sire and dam than if it is worked out by tracing descent along a few ancestral lines. by tracing descent along a rew ancestal miles. In calculating the Futurity Index equal value is given to the "breeding factor" of the sire and the dam. In figuring the breeding factor of the sire, consideration is given to his racing capacity, to the racing capacities of bis sire and dam, and to the racing capacities of the foals he already has produced. The breeding factor of the dam is calculated in the same way. These two breeding factors are combined to form the Futurity Index of the foal.

IN THE hest breeding establishments only the cream of the thoroughbreds are dealt with—sires and dams with near kin of proved high racing capacity. With such stock the Futurity Index of the foals is very high. For example, for forty-two racing foals hred at one famous farm it averaged 116.1. But the average actual racing capacity of those foals

was strikingly lower-97.75. Studies in heredity had led Dr. Laughlin to expect this. But the apparently disappointing result has a counterbalance. If sires and dams of sound thoroughbred stock, but of lower racing capacities than the top notchers of the hreed, are selected, and the Futurity Indices of their prospective foals computed, the Futurity Index values will be low. But the actual racing capacities of these foals will be higher than those of their parents. Whether the sires and dams are the leaders of the thoroughbred world, or rank among the minor nobility of that equine aristocracy, most of their foals will swing down or up toward the average of the breed.

This "regression phenomenon" is character istic of all hreeding experiments with stock of measured quality. Just how much this drag toward mediocrity amounts to in pulling down the offspring value of exceedingly superior parents, and in raising the offspring value of inferior parents, when all are drawn from the same breed, is one of the problems that Dr. Laughlin's researches bave solved.

ALTHOUGH offspring of the best of any breed are more likely to fail to equal, than they are to exceed, the capacities of their parents, still occasionally a foal will equal the promise of its Futurity Index, or even exceed it—and the selection of these few shining successes among many comparative failures gradually will improve race horses.

So the Standard Horse, the ghost entry that runs in every race, leads the thorough-hred field into the future. Challenged often by his flesh-and-blood rivals, he is beaten only occasionally by some champion of champions like mighty Man o' War.

SLANTING OIL WELLS WORK NEW MARVELS

(Continued from page 41)

the perpendicular, out of control of the driller. It was not uncommon for a 5,000-foot hole to end its course 1,700 feet out from under the derrick !

Drillers learned how crooked their wells were when new instruments were devised to chart the hole. Bottles containing hydro-fluoric acid were lowered into the hole and allowed to stand until the acid had eaten into the glass, etching a mark which showed how much the hole was tilted. Later, elaborate machines were devised, which could be run up and down to produce a written or photo-

WHILE engineers have been perfecting W new methods of drilling straighter, a new school of experts has arisen who are reversing ordinary procedure by purposely drill-

ing on a slant. Their operations caused a furore. Recently, rumors of such drilling sent state oil sleuths secretly investigating fifty mystery wells that were being drilled along the coast of California. Suspicion was aroused when, in the middle of an old, dying field, a new well suddenly roared into life with a heavy flow of oil. Old wells adjoining were nearly lifeless and had to be pumped. Soon a whole series of gushers burst into heavy production.
Geologists were astonished. They knew

Geologists were astonished. They knew the old field was nearly exhausted. Another and richer oil sand was known to underlie the ocean, but it was separated from the old pool by a fault. Had the mystery wells crossed the fault, to penetrate this submarine zone?

Drillers were tight-lipped and uncommu-nicative. State operatives did under-cover investigation. Suddenly a veritable bombshell was exploded. The owners of all fifty wells were brought into court and charged with mechanically deflecting their wells out under the ocean and filching oil from publicly-owned tidelands at the rate of some fifteen million harrels annually

To reach the submarine pool, drillers of the new wells had to drive their bits almost 1,000 feet seaward, crossing under a strip of beach land owned by a large oil company. Soon two old wells in this strip along the ocean were pierced by the bits of drilling wells. Little doubt existed that all fifty wells were aiming at the rich store of oil underlying state prop-

As this is written, the case is still pending, while state officials and officers of the oil companies involved are trying to reach an agreement whereby the slant-drilled wells will be allowed to tap the pool if they pay a royalty percentage into the state treasury.

THE newly developed technique of slant drilling may be utilized to develop unexploited fields in inaccessible locations, or to reduce the number of holes that must be drilled to drain all the oil from subterranean storage. In some localities, the cost of erecting a suitable foundation for an oil well is almost prohibitive. For example, in parts of Venezuela, where the oil underlies deep lakes or bays, the cost of making a suitable foundation is greater than the whole drilling cost of the well. Simply by drilling along the shore, and deflecting the bit out under the lake, this huge expense may be saved.

A revolutionary scheme for reducing the number of wells necessary in an oil field, has been proposed by an expert who suggests that each well be used as a center for four or more holes, all drilled from one derrick but diverging at the bottom so as to drain a large terri-Each territory would thus be the nucleus of four or more pipes, each correspond-ing to an ordinary well. Such a system would greatly reduce the cost of developing an oil field, and make it much simpler to pump.

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DEADLY SNAKE POISON NOW USED TO SAVE HUMAN LIVES

(Continued from page 30)

and the rattlesnake both strike, stabbing the flesh of their victims. The cobra, with its shorter teeth, suggesting stubby rose thorns, chews after it strikes, drenching the wound with venom and making a number of incisions.

Armed only with a slender rod about two and a half feet long, having a bort crosspice at its head, Ditmars moved quietly to the table. The stick was just long enough to keep his hand a few inches beyond the farthest reach of the fangs. As the mocasin hy table and grasped the scaly nock just behind the jawbones. His fingers were hardly an inch and a half from the curved fangs in the wideopen mouth. An assistant held the body of the snake from coiling around Ditmar's arm. Even a momentary loosening of his grip would allow the twisty snake to turn its head hollow teeh high the proposed in the scale of the state of the state

IFTING the head to the edge of a heavybottomed tumbler covered with tightly
stretched gauze, Ditmars plunged the teeth
through the cloth. A contraction of the musthrough the cloth. A contraction of the musof poison. In the bottom of the glass it looked
like orange juice. Some snakes carry more
than 100 times the venom required to kill a
man. When Ditmars finished massaging the
property of the property of the property of the
the poison, more than a teaspoonful of the
prightly-colored liquid covered the bottom of
the glass. He lowered the head to the table
and released it with a quick upward filet of

That last moment when the snake is released is a critical one. A few years ago, Fred Taggard, one of the keepers at the snake house, finished removing a bit of skin from the eye of a copperhead which had had trouble in shedding. As he dropped the snake to the floor of the cage, it shot upward like a rubber ball, driving its fangs into a thumb. Fortunately antivenom was available and a quick injection saved his life.

The first antivenom was made by Dr. Albert Calmette, at the Pasteur Institute, in Lille, France. He was also associated with some of the early work of Dr. Monealesser, and antivenom laboratories in various parts of the world. The first of these was established near Sao Paulo, in Brazil. The work was believe the property of the broad that the world was believe the property of the world. The hondurus, another snake farm provides serum against the poison of Central American snakes and at Bankok, Slam, a laboratory the Old World. A snake farm at Glenolden, near Philadelphia, Pa., supplies the antivenom for North America. The laboratory at Port Elizabeth, where the work in venne and its ble for combatting wenomes makes in Africa.

EVERYONE who catches a poison snake in brazil is required by law to forward it to the Sao Paulo farm. Railroads transport the containers free of charge. Mail time at the farm is the most exciting period of the day as an average of twenty deadly snakes arrive with each delivery.

The method of preparing the antivenom is relatively simple. The extracted poison is diluted with salt water and bit by bit injected into healthy horses under the skin of the neck. Each dose is larger than the preceding one. At the end of six months, the animal can stand shots of venom fifty times as powerful as would have been required to kill it when the injections began. What happens inside the horse is another mystery. In some way its blood manufactures an element which combats the poison. At the end of six months, eight quarts of the animal's blood is drained off painlessly and placed in sterilized containers. The blood clots and an amber-colored serum forms.

CONCENTRATED and sterilized, it is put only in plass tube, seeled at both ends and containing about three teaspoonfuls. The tubes sell for ten dollars aplece, and are labeled according to the type of venom they are able to combat. The full remains effective the self-grant self-grant the total conduct the full remains effective the self-grant self-gra

Before antivenom was available in America, a United States army officer, Col. Martin L. Cummins, while stationed in Texas, built up partial immunity to venom by small injections over a period of years. As a result, he was able to save a number of lives through transfusions of his blood into the veins of bitten children. Because his life stream had devel-fulled the compact he such a compact he such police, it acted in the veins of the victim much as antivenom does.

At the Sao Paulo farm, in addition to preparing antivenom, the experts are combating poison snakes in another way. They are raising massarambas, powerful non-poisonous black snakes that attain a length of eight feet and live on fer de lances and other dangerous serpents of the country.

Another attempt to use the natural enemies of snakes has proved less successful. The mon-goose, which kills the cobra in the Orient, has been imported into Central and South American the Contral that the contral that the contral that the contral that the colors, which rears up and fights high, the mongoose is less able to sidestep the low-strikling snakes of the new world. Contrary to general opinion, these animals are not immune to poison. They are simply quicker less susceptible to snake venom, the frog, for instance, being able to stand twice as much rattlesnake poison as the guines pfg, so-called immune animals are usually either quicker fangs do not penetrate.

D'ERING one series of the medical experiments, it was found that dried venom retains its potency for many years. One sample five years old showed practically full strength and another twenty years old proved to be highly active. Dr. Monaelesser found that highly active. Dr. Monaelesser found that we have the power of the cobra poison, he subjected it to a treatment of X-rays before preparing it for injection. A nother fact discovered is that the venom of North American they come out of bleeration spering. When they come out of bibernation spering.

In various parts of the world, free lances are engaged in the risky business of catching snakes and selling venom. One of these adventurers, W. E. Jones, has spent thirty-five years in the heart of Zululand destroying puff adders, mambas, and cobras, sending the dried venom out to various laboratories.

Looking ahead, experimenters are now preparing not only to counteract the effects of deadly venom, but actually to use it in fighting disease. To the hundreds of thousands of victims saved by antivenom, they hope to add other thousands brought back to health by dramatic new applications of restile poison.

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RACING HOMEMADE MIDGET AUTOS

(Continued from page 28)

ciation, and signed up the eligible drivers. He started the racing, and drivers began to flock in. The idea caught on like wild fire, A few hundred people witnessed the first events at Loyola, an athletic field hidden be-hind the high green fences back of Loyola high school. Soon Distarce was packing 'em in. As many as 7,000 people have crowded into the field during a single evening.

Distarce told me he planned from the out-

set to do two things: give the public thrills without constant danger to the drivers and limit the speed of the cars to a point where the boys would not break their necks every time they raced. He requires all cars to appear at the tracks in a presentable condition and to meet the approval of critical inspectors. The drivers must show up in clean uniforms with helmets to match. But the most important regulations apply to the cars.

They stand only twenty-six inches in height, have a tread of forty-two inches and weigh from 500 to 850 pounds. They cannot use superchargers and piston displacement is limited to 100 cubic inches. Only one carburetor may be used, and automatic or pres-sure type fuel injectors are strictly taboo. These rules apply to four-stroke cycle motors. As for two-stroke cycle engines, any-thing goes within the limit of sixty-one and one-half cubic inches of piston displacement.

LIKE their big brothers of the more famous tracks, these little fellows are equipped for quick "cut-off" in case of trouble. Fuel systems and electrical circuits are provided with shut-off devices, short-circuiting buttons, and switches within easy reach. The drivers are warned to keep their head above their cowls and always to keep a sharp look-out for other cars. Tommy Phillips, ducked to look at his oil pressure gauge the other night. Before he came up for air, he had run over the rear left wheel of "Red" Frick's car, turned three somersaults, and came to rest upside down.

rest upsace down.
His first question, when he regained con-sciousness in a hospital, was: "Can I get 'er fixed up to run next week?" The next Thursday he was racing again!
These rules, which the Association invokes on all comers alike, will give you a clearer

idea of these tiny speedsters; Wheelbase may not exceed seventy-six

inches nor be less than sixty-six inches from axle to axle. Tread may not exceed forty-five inches

nor be less than forty inches. Wheels may not have a rim diameter greater than twelve inches nor less than ten inches.

All cars must be equipped with flexible, spider-type steering wheels and suitable brakes, with a fire-proof wall between driver and engine.

All cars must carry manually operated clutch, and exhaust pipe extending beyond the rear axle housing.

All cars must carry a gasoline tank constructed of eighteen gauge material.

All cars must have a road clearance of four inches or more.

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HIS book was prepared for men of ideas-men who have an article in mind that will make money, save money, save labor or give pleasure. Leading thinkers agree that the world of a few years from now will be radically differ-ent because of the contributions to progress that inventors will make. Now is the time—if you have an idea—to see about protecting it,

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Raising Tropical Birds for Fun and Money

(Continued from page 37)

window, but as they play and make love when they are not aware of an alien present. Bear in mind always the comfort of your tenants. Be sure to have the cage or aviary ready for occupancy when your hirds arrive, and also to have seed pans and drinking cups placed in the most conspicuous places to make sure the timid little creatures places to make sure the timid little creatures supply of each placed near the perches, since some varieties may not come down for food

during the first few days.

Provide the newcomers with distilled or boiled water for a day or two, then change gradually to your usual local supply. This will prevent diarrhoea. Cover the bottom of look the grit. It serves as the birds' texth and is necessary to thorough mastication of food. A little grit on the floor helps also to keep their feet clean. Always keep a piece of cuttlebone fastened to the cage off the of cuttlebone fastened to the cage off the state of the control of

Birds are very much like young children when their routine is upset. Siza wawy from the new arrivals until they have rested from their trip, no matter how short It may have been, and keep them quiet and out of drafts. The state of the stat



As far as known, this is the only pair of laughing jackasses in America. Native to Australia they were imported after birth

exercise to keep themselves warm. Again, like children, they have their peculiar preferences. Most of the finch family like to sleep in little nest boxes or gourds and you will make them happier by supplying these conveniences. The gourd may be prepared easily by rounding out on one side a hole and the supplying the supply

and placing nesting materials within.

When the little creatures become accustomed to their new home you will witness a busy, happy family. Give them surroundings they like and they actually will improve their own strain.

their own strain. For best results in cage breeding, a proper case must be provided. It should be considered to be considered



This practical food hopper for an outdoor aviary has room for grit, nesting food, and seed

around the sides and top. Feed the proper seed mixture, cuttlebone, health grit, and

Birds may be bred also in the large, outdoor aviary, or in boxes. In the former case, be sure to have an equal number of males and females to avoid jealousies, and a few more nests than pairs in order to give them some freedom of selection.

If you want to raise finger-tame birds, as nearly everyone does, adopt the box-breeding method. The box for a single pair should be at least fourteen inches by fourteen inches by fourteen inches by fourteen inches box of these general proportions will serve the purpose. Nail across the open end, a board one and one-half inches wide to prefront with three-fourths inch mesh, place a perch in convenient position, cut a door at one end, and hang a nest box on the outside cage you can fondle the young daily, and thus keep them tame.

No step in the care of your birds is more important than correct feeding. While food requirements are simple, remember that birds appreciate quality feed. Parrakeste require a seed mixture containing millets, hulled oats, and plain canary seeds. Many birds starve with full cups before them. It is well, therefore, to accept the advice of the proprietor of a pet shop, who can prescribe the proper diet.

From babyhood to old age, your feathered pets will require little care if you give them proper food and protect them against drafts. When Illness visits your aviary, be sure to keeps the birds warm both night and day until they are completely cured. Some of the more common ailments include asthma, colds, sore eyes, baldness, egg binding, broken legs, mites, eastly legs, sore feet, and diarrhoes.

MOULTING is not a disease, but is a perfectly natural annual occurrence, usually beginning in mid-summer and lasting four to six weeks. During this time, feed your birds fresh, wholesome seed.

Usually no one but the owner can be blamed when one of his feathered beauties contracts asthma, for it results usually from the inhaling of dust from stale droppings or musty seeds. This condition may he avoided by keeping the cage clean. The treatment for asthma includes two drops of iodine daily for every two ounces of the drinking water, a drop of honey applied to the inside of the throat with a leather and mentholatum in the nostrils. If after two days the bird shows improvement, omit the iodine. Feed plenty of fresh food, but only after it has been washed and dried well with a cloth.

If the little fellow sits on his perch with feathers puffed up, shivering and sneezing, he has a cold. To cure this in short order, touch the nostris with a small bit of mentholatum on a tiny stick. Dissolve one rounded teaspoonful of Epsom salts in a pint of boiled water and give this to him in his drinking keep to the control of the

D'Go linding may be quickly diagnosed. She will first sit on the perch, feet apart, feathers puffed and eyes strained. Later she will huddle disconsolately in one corner on the floor. An effective treatment mouth, with the addition of mineral oil injected in the vent. This may be given by holding the blrd in the left hand on its back with the head pointing away from you, the work of the contract of the contract

Birds respond rapidly to treatment for broken less. The best splint for this purpose is made by taking a quill feather and striplength depending upon the length of the ket to be treated; split the tiny piece of quill down one side, spring it open, place the key in it and press the quill back together. Then place the bird on the floor of a cloth covered place the bird on the floor of a cloth covered moved, with food and water within reach. The bone should kait in about five days.

A good mite powder, rubbed in through the feathers, will chase way these parasites. By washing the legs in clean, warm water, by washing the legs in clean, warm water, a good salve, selly legs should, and in the property of the control of the control of the property of the control of the property of the property of the premises is suggested; for the latter, in regions where mosquitos flourish, place a mosquito net around the cage at night.



Illustration shows a homemade breeding cage that can easily be put together by anyone



THE AIRFLOW CHRYSLER IS THE WORLD'S FIRST BUILT-FOR-THE-PURPOSE CAR

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The power required to drive the car increases as the cube of the speed. On a 1933 car, to overcome air resistance alone at 40 miles per hour, required seven of the available horsepower. To overcome the wind at 80, required fifty-six horsepower.



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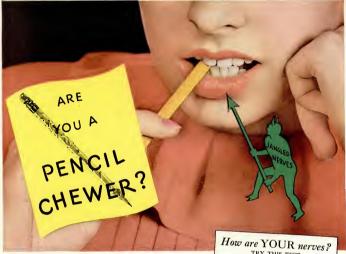
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